Scientific Refutation

This scientific refutation relates to the Intergovernmental Panel on Climate Change's (IPCC) key-risk assessment as detailed in the Fifth Assessment Report (AR5): the basis of United Nations member state government risk-mitigation plans and associated policies.

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Advocate for Natural Climate Change Risk-Mitigation: Switching to Renewable Energy and Implementing Centralized/Decentralized Sustainable Development (**Urgently**)

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Introduction to this Scientific Refutation

In the interests of ensuring the safety of 7.7 billion people there is an urgent need for a scientific revolution in the climate science field (i.e., a paradigm shift).[1] Catastrophic natural climate change risks like global cooling, climate forcing volcanism, rapid climate change, glaciation, grand solar minimum related extremes of precipitation and pandemic influenza **remain unmitigated**. These 21st century relevant natural climate change risks were dismissed or omitted by the Intergovernmental Panel on Climate Change (IPCC) from its climate change key-risk assessment in the Fifth Assessment Report (AR5).

This risk dismissal-omission eliminated all cooling contestation to the IPCC's politicized Representative Concentration Pathway (RCP) global warming scenarios and its key-risk assessment, and is without scientific merit. A corruption of normal-science has taken place in the climate science field since 1990 ("corruption") enabled by United Nations Framework Convention on Climate Change (UNFCCC) Articles 1 and 2,[2,3] and the IPCC's bias-enabling processes and procedures.[4,5,6,7,8] A scientific revolution is required to overcome this corruption so catastrophic risks can be unveiled and urgently mitigated.

For clarity, the UNFCCC Article-1 definition for climate change is fundamentally different to natural climate change, as are the UNFCCC Article-2 dictated key-risks. The only climate change key-risk assessment that matters to governments is what the IPCC hypothetically contrived in AR5 under a constraining UNFCCC Article-2 diktat linked to theoretical anthropogenic global warming (AGW).

We are categorically told by the IPCC Working Group 2 (WG2) of the constrained nature of their key-risk assessment; "*Key risks are potentially severe impacts relevant to Article 2 of the UN Framework Convention on Climate Change, which refers to "dangerous anthropogenic interference with the climate system*,"[9,10,11] and that we can reduce the impact of climate change (and therefore the key-risks) by reducing our emissions.[12] This Article 2 diktat means the IPCC only assessed hypothetical key-risks associated with theoretical anthropogenic global warming (AGW).

When you analyze the full repertoire of climate, solar activity, volcanic eruption, and pandemic influenza outbreak data and review the full scope of the scientific literature, it becomes clear the most relevant natural climate change risks for the 21st century, which were also in plentiful evidence since the Arctic's Holocene Climate Optimum (HCO) eight millennia ago, include; global and regional cooling cycles, grand solar minimum related extremes of precipitation, glaciation, climate-forcing volcanism, rapid climate change, and pandemic influenza. This current and most extreme outlier Arctic warming phase since the Arctic's HCO will in all probability abruptly switch to a cooling and glaciation phase during the 21st century (P-value <0.05), as we return to the ice age from which we emerged at the end of the Little Ice Age (mid-13th to mid-19th centuries).

The key points underpinning this scientific refutation

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The following summarizes incriminating disclosures and pertinent climate data that refute the IPCC's radiative forcing theory and climate forecasts, and undermine the validity of the its AR5 key-risk assessment (fully cited in the following sections). The IPCC;

1) Disclosed its use of global climate indices that have been sequentially altered ("**fabricated**") by UK and US government (MetOffice, NOAA, NASA), evidenced by subtracting post-1990 global climate index versions from the current versions.
2) Projected a 2016-2035 global mean surface temperature (GMST) increase of 0.3°C-0.7°C. Between early 2016 and mid-2019 the **GMST declined 0.47°C** while CO2 increased 2.8%.
3) Disclosed its **highly inaccurate** climate forecasts: 1986-1998; 84% under-forecasted the GMST. 1998-2012; 97% over-forecasted GMST, while 100% failed to predict the 15-year climate hiatus (no GMST increase) during this same period when CO2 increased by 8.0%. Points 2 and 3 clearly show the IPCC theory and models are unable to predict the GMST and its natural oscillations, thus **refuting its theory**.
4) Failed to inform governments this warming phase started in the early 1700s, in the depths of the Little Ice Age and long before significant human greenhouse gas emissions. This warming phase was highly correlated with a grand solar maximum phase of solar activity (i.e., electromagnetism and magnetized solar wind).
5) Omitted to explain that a **major glaciation phase** started after the Holocene Climate Optimum, which tracked a 40-50Watt/m^2 decline in solar irradiance (i.e., 15 times today's putative human radiative forcing impact) and a 5°C decline in polar ice core temperatures by 1700CE. This glaciation peaked during the Little Ice Age, and its melt initiation preceded significant human activity. Despite five-millennia of glaciation up to the mid-19th century, the IPCC erroneously dismissed with virtual certainty the prospect of glaciation for the next 1,000 years.
6) Erroneously **delayed the next ice age** by an unprecedented 30,000-50,000 years, while stating the last ice age ended about 10,000 years ago. The ice age delay is statistically falsifiable on three counts, never mind its conflict with existing data.
7) Erroneously dismissed as not applicable today the climate change **risk lessons** from the Little Ice Age and rapid climate change events since just before the Holocene Climate Optimum, associated with famine, war, and epidemic related catastrophes, civilization destructions and species extinctions.
8) Erroneously dismissed or omitted **catastrophic natural climate change risks** most relevant to the 21st century, which have been in plentiful evidence over the last eight millennia i.e., cooling cycles, grand solar minimum related extremes of precipitation, glaciation, climate-forcing volcanism, rapid climate change, and pandemic influenza.
9) Omitted to disclose that **leading solar activity scientists** expert in climate change have warned of a return to a Little Ice Age-like climate during this current grand solar minimum period.

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10) Failed to provide a detailed **correlation analysis** (since 1990) between CO2 and the GMST, because this analysis does not support their cause and effect relationship. This lack of bonafide correlation helps explain the IPCC's high forecast inaccuracy.

11) Confirmed we only have **decades of proven oil and gas reserves**, which is insufficient to generate the full 21st century global warming that we are fear-mongered with, let alone delay an ice age. With reserves-to-production for oil and gas being less than 100% for most of the last 40 years, peak discovery is history. As such, all IPCC climate forecasts are **technically invalidated**.

Anthropogenic global warming is a fabrication that hijacked a natural warming phase that started in the early 18th century

Underpinning the IPCC's key-risk assessment are the following cited global warming projections, which include, "*The global mean surface temperature change for the period 2016–2035 relative to 1986–2005 will likely be in the **range of 0.3°C to 0.7°C** (medium confidence). This assessment is based on multiple lines of evidence and assumes there will be **no major volcanic eruptions or secular changes in total solar irradiance.***"[13] These unrealistic assumptions serve to eliminate important natural cooling contributions from IPCC forecasts.

According to four different climate indices the global mean surface temperature (**GMST) declined by an average of 0.47°C** between early 2016 and mid-2019,[14] rendering the IPCC's 2016-2035 GMST forecast inaccurate. This recurring GMST forecast inaccuracy *exacerbates* the IPCC's self-disclosed multi-decade legacy of generating *highly inaccurate GMST forecasts* (see slide deck #22).[15] This under-forecasting (1986-1998; 84%) and then over-forecasting (1998-2012; 97%), while 100% failed to predict the 15-year climate hiatus (1998-2012),[16] as well as the fall in GMST since 2016, confirms **something else is controlling** the GMST and its multi-annual- and decadal-scale oscillations—and therefore, the **climate risks**.

Moreover, the 15-year climate hiatus occurred while carbon dioxide's **(CO2) atmospheric concentrations increased by 8.0%**, and the Q1-2016 to Q2-2019 GMST decline occurred when CO2 concentrations increased by 2.8%.[17] This indicates that CO2 does not control the GMST—just as the IPCC-ignored science tells us.[18,19,20,21,22]

Thomas Kuhn, one of the most influential 20th century philosophers of science and author of "*The Structure of Scientific Revolutions*," tells us **a scientific theory must be rejected** when the outcome predicted by that theory is different from nature.[23] Therefore, on the basis of the IPCC's abject failure to accurately predict the GMST and its oscillations for thirty years "normal-science" should **refute** the IPCC's radiative forcing theory and the validity of its UNFCCC Article 2 constrained key-risk assessment.

Further undermining the validity of "anthropogenic" global warming, is the fact that the global climate indices (HadCRUT4, NASA, NOAA) used by the IPCC in its AR5 forecast inaccuracy analysis[15] have been sequentially altered since 1990 ("**fabrication**"), with each

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new index version. This fabrication can be comprehended by subtracting the earlier global climate index versions from their current version (see endnote graphic and slide deck #21).[24] These fabrications have artificially accentuated the post-1880 global warming, making these climate indices **unfit for policy sensitive decision-making**.[25,26]

By comparing the modern era's fabricated GMST peak in 2016 with the GMST in 1850, a 1.17°C rise,[27] we are led to believe this is the **highest temperature on record**.[28] However, when today's temperature is compared with the Holocene Climate Optimum's peak temperature 7,980 years ago, then that record highest temperature actually represents a decline of 1.9°C.[29] According to the literature, Arctic ice core temperatures were 2-4 degrees Celsius higher during the Holocene Climate Optimum than today.[30,31,32]

In reality this Arctic, Northern Hemisphere and global warming phase actually started in the **depths of the Little Ice Age** (i.e., in the early 1700s)(see slide deck #19 and its **nine cited datasets**[33]),[34] long before the fabricated global climate index start dates (i.e., 1850-1880 CE). Working Group 1 even admit the warming started before significant human greenhouse gas emissions, "*The combined records indicate that a net decline of global glacier volume began in the 19th century, before significant anthropogenic RF had started, and was probably the result of warming associated with the termination of the Little Ice Age*."[35] Therefore, by focusing society's attention on GMST since 1880CE the IPCC have **majorly disoriented society** as to our correct glacial cycle stage (see below).

To better understand today's climate change discussion it is helpful to understand the Arctic temperature declined by 4.86°C between the Arctic's Holocene Climate Optimum and 1700 CE, before then rising.[36] This decline took place in an oscillatory manner on multi-decadal to centennial time-scales, and comprised 39 temperature increases exceeding 0.99°C (trough-to-peak phases, range 1–15 decades, mean 88 years) among smaller multi-decadal temperature oscillations. Between 1700 and 1940 Greenland's ice core temperature increased 2.87°C, which represented the most **extreme outlier** warming phase in 8,000 years. This extreme outlier status preceded significant human greenhouse gas emissions (see slide deck #9).[37] The second most extreme Arctic warming phase in 8,000 years occurred just prior to the 4.2 kiloyear rapid climate change event that was associated with the collapse of ancient Egypt's Old Kingdom,[38,39]Mesopotamia's Akkadian Empire,[40] and the Indus Valley Culture.[41]

Finally, in case you overlooked this fact, **no detailed correlation analysis** was ever provided by WG1 (in ARs1-5, since 1990) between the GMST and CO2, covering decadal-, centennial-, millennial-, and glacial cycle-time scales, or comparing it with solar irradiance and magnetized solar wind etc., to justify the IPCC's radiative forcing theory. This omission is because a correlation analysis does not support a cause and effect relationship between CO2 and GMST (see slide deck #8 and #10), evidenced by CO2's failure to follow the multi-annual to decadal temperature oscillations (i.e., see slide deck #10 and CO2's periods of non-significant correlation). The scientific literature shows the rise in atmospheric CO2 concentration follows the temperature rise.[18-22] Interestingly, the Northern Hemisphere temperature was highly correlated with a grand solar maximum

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phase of solar activity (i.e., electromagnetism and magnetism), in a delayed or a lagged manner (See slide deck #8 and #10).

The IPCC systematically disoriented governments as to our glacial cycle stage; meaning catastrophic risks are veiled from common view

To undermine any scientific contestation to its four Representative Concentration Pathway (RCP) global warming scenarios and its key-risk assessment, the IPCC has effectively **disoriented governments and society** as to our real glacial cycle stage, 8,000 years after the Arctic's Holocene Climate Optimum. This disorientation was achieved by erroneously delaying the next ice age by an unprecedented and refutable 30,000-50,000 years,[42,43] by incorrectly stating that the last ice age ended "*about 10,000 years ago*,"[44] and by focusing government and society's attention on a post-1880 fragment of a natural warming phase that started in the Arctic in 1700 CE. In so doing, the IPCC has removed catastrophic natural climate change risks from common view, while it manipulates the world with fabricated global climate data.

Therefore, to help re-orient you to our real glacial cycle stage, so you may appreciate the catastrophic risks lurking on our horizon, it is necessary to review the long-term global and polar climate data relative to common points of glacial cycle reference, i.e., the **climate optimum** and **glacial maximum** (see endnote).[45] For consistency across all glacial cycles, an ice age ends just after the glacial maximum, which corresponds to the lowest glacial cycle temperature just prior to the interglacial temperature rise. Therefore, the last glacial maximum was reached between 24,098 and 22,010 years ago in Greenland (GISP2[46] and GRIP[47] respectively), between 19,300 years and 18,953 years ago in Antarctica (Dome Fuji[48] and Antarctic Dome-C[49] respectively), and globally 19,600 years ago.[50]

The Holocene Climate Optimum (HCO) on the other hand corresponded with the peak glacial cycle temperature, at the end of the Holocene interglacial temperature rise. After a glacial cycle's climate optimum, an ice age begins and the temperature declines. The HCO was reached in Antarctica between 10,570 years (Dome-C,) and 10,100 years ago (Dome Fuji), in the Arctic between 7,800 (GISP2),[46] 7,980 (GIS),[51] and 9,384 (GRIP)[52] years ago, and globally by 2,100 years ago.[53] In general, according to the last two paragraphs cited data, the climate optimum was reached first in the Antarctic, then the Arctic, and then globally (see endnote table[95]) over the last 800,000-1,000,000 years. In all cases the polar and global temperatures declined in an oscillatory manner after the Holocene Climate Optimum, **reflecting our ice age entry.**

The IPCC obviously ignored the above two paragraphs widely cited climate data and their readily retrievable glacial cycle reference points because they told governments, "*Since the end of the last ice age, **about 10,000 years ago**, global surface temperatures have probably fluctuated by little more than 1°C.*"[54] The actual end of the last ice age is different from this opinion**,** in that by "*about 10,000 years ago*" the global sea level had *already* risen 80% and the temperature 90% of their total Holocene interglacial rise.[55] The IPCC's timing for the **end of the last ice age is categorically refuted**.

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Looking closer at the Greenland ice core, it is clear that a new ice age commenced after the Holocene Climate Optimum in the North Pole because the temperature declined by 4.86°C between the Holocene Climate Optimum (5980 BCE) and 1700 CE.[56] This Arctic temperature decline represented about one-fifth of its Holocene interglacial temperature rise (in absolute magnitude).[57] Likewise, a new ice age commenced in Antarctica about 10,500 years ago, evidenced by the temperature declining 4.56°C between 8577BCE and 1738CE. This Antarctic temperature decline represented about one-third of its Holocene interglacial temperature rise (in absolute magnitude).[58] It is important to understand that these polar temperatures declined after the Holocene Climate Optimum in a *devolving oscillatory manner*, on multi-decadal to centennial time scales. This means earth exists in **sequential warm and cold phases** that get progressively colder as an ice age progresses.

Data depicting orbitally induced changes to solar irradiance (i.e., precession of the summer solstice) since the Holocene Climate Optimum also confirms that **earth entered a new ice** age 8,000 to 10,000 years ago in the Arctic. Precession modified solar irradiance **declined 40-50 Watts/m^2** at 65°N latitude since its Holocene Climate Optimum peak.[59,60,61] (i.e., 15 times today's putative human radiative forcing impact).[62] This millennial-scale decline in solar irradiance paralleled the decline in northern hemisphere temperatures over the same period.[63,64]

The above two paragraphs *help explain* the significant glacier ice buildup that took place after the Holocene Climate Optimum (HCO). Strangely, this ice build up is 'only' referred to as *neoglaciation* in the scientific literature*,* rather than an ice age inception. Less polar glacier ice was present at the HCO **than today**, and Greenland's ice sheet margins had retreated to less than their current extent between seven and four thousand years ago and reached their minimum extent between five and three thousand years ago. The Arctic's zone of coastal ice melt also retreated five hundred kilometers farther north, and there were summers free of sea ice.[65,66,67,68]

From about five millennia ago **significant ice mass began to accumulate** at both poles, particularly during the second millennium CE.[69,70,71,72] In the Arctic this glaciation is evidenced by an abrupt ice accumulation along Greenland's north coast starting 5,500 years ago, and northeast Greenland was ice-locked by about 3,000 years ago.[73] In Greenland's southeast, today's Kulusuk glacier region had been ice-free during the climate optimum. Then, between 4,100 and 1,300 years ago, there were six major glacial advances, which coincided with major cooling episodes in the North Atlantic Ocean.[74] Glacier size peaked by the end of the Little Ice Age,[75,76] with winter sea ice closing off previously accessible sea routes between Scandinavia and Greenland.[77] Switching focus to the South Pole, even with the global ice melt since the mid-19th century[78,79,80] the inner Antarctic ice domes are still **100 meters higher today** than at the HCO.[81]

Without emphasizing or giving context to this major ice build up after the Holocene Climate Optimum, WG1 tell us the polar glacier melt-initiation started in the mid-19th century, "*before significant anthropogenic RF* (i.e., radiative forcing) *had started, and was probably the result of warming associated with the termination of the Little Ice Age*."[82] That is to say, natural climate change controlled the rising temperature from the early 18th

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century[33,34] and it's associated ice melt, and long before the IPCC's hypothetical anthropogenic global warming story **hijacked or rebranded** this natural warming phase.

Given the above-cited temperature and solar irradiance data and their Holocene Climate Optimum (HCO) timings and subsequent declines, as well as the major glaciation that took place from five millennia ago it is almost comical, veiled catastrophic risks aside, AR4's WG1 biasedly and erroneously **delayed the next ice age** by an *unprecedented* 30,000 years, and advised governments that this represented a "*robust finding,*" [83] without providing any data evidence to support that assumption. AR5's WG1 further delayed the next ice age by a contingent 50,000 years, while also telling governments it is "*virtually certain*" that glaciation will not occur within the next 1,000 years.[84] None of these ice age delay opinions by the IPCC were subject to peer-review scrutiny or reflected the historical climate data.

The above cited 'virtual certainty' failed to reflect the five millennia of ice build up after the Holocene Climate Optimum and its factors of causation (i.e., solar electromagnetism and magnetism, orbital modulation of solar emissions, volcanism, geomagnetism, etc.), or our limited 'proven' oil and gas reserves available (see endnotes[342-351]) required to warm the planet and delay an ice age as the IPCC predict. The 50,000-year contingent delay also assumed the Article 1 and 2-installed radiative forcing theory was correct, even though the IPCC's CMIP5-championed models were unable to accurately predict GMST over the last 30 years using that theory.

Crucially, WG1 failed to provide any **statistical validation** for extending the already longest inter-climate optimum interval in 2 million years by another 30,000 years. A 30,000-year delay would create an extreme outlier (P-value <0.05) and convert two million years (33 glacial cycles) of global inter-climate optimum interval data from a normal to a non-normal distribution, [85] thus falsifying their putative ice age delay. Two other **statistical falsifications** of this 30,000-year delay are detailed in the following endnotes. These falsifications impact the Antarctic-to-global climate optimum phasing gaps and the interglacial durations, for 800,000 and one million years of glacial cycles respectively.[86,87]

The previously cited decline in precession modified solar irradiance (40-50Watts/m2 @65°N)[59-64] and its corresponding millennial-scale decline in the temperature (approximately -5°C) confirms earth entered a new ice age after the Holocene Climate Optimum. This significant solar irradiance and temperature decline also **falsifies** the IPCC's *theoretical* 30,000-50,000 year ice age delay.[83-84] Working Group 1 justified this ice age delay by relying on a contentious scientific theory regarding Milankovitch cycles,[88,89,90,91,92,93] "*The Milankovitch, or 'orbital' theory of the ice ages is now well developed.*"[94] In making this Milankovitch related prediction the IPCC failed to provide its modeled assumptions underpinning its statement, "*Understanding of the Earth's response to orbital forcing indicates that the Earth would not naturally enter another ice age for at least 30,000 years.*"[94] This *prediction* is falsified because it contradicts the previously cited *historical* precession modified solar irradiance and temperature data.[59-64]

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More simplistically, you only have to analyze the mean inter-climate optimum intervals globally (average 93,000 years) and in Antarctica (average 97,000 years) from the last one million years, and their approximate **19,000-year standard deviation**, to realize there is no Milankovitch "100,000 year eccentricity clockwork-pacemaker" controlling the start (or end) of ice ages.[95] The IPCC's ice age delay is **categorically refuted**.

The above paragraphs highlight that by not reflecting climate change in the polar regions and glaciation back to the Holocene Climate Optimum, we **lack a bearing** on the real stage of the glacial cycle that we exist in. This lack of bearing has then enabled society's **manipulation** by the IPCC with fabricated climate index data.

By analyzing the Greenland ice core climate oscillations since the Holocene Climate Optimum, our 21st century **abrupt ice age re-entry fate** becomes evident. All previously discussed 39 Arctic-warming phases in the last 8,000 years exceeding +0.99°C from their deepest trough to their tallest peak **switched to a cooling phase** after an average of 80 years. This current extreme outlier Arctic warming phase that started in 1700CE was *long overdue for a switch to a cooling phase decades ago*, and long before significant human greenhouse gas emissions were a theoretical issue (i.e., pre-1940). Outlier Arctic warming phases fell abruptly by -1.9°C compared with non-outliers -1.03°C, and both within four decades (P-value <0.05)(see slide deck #9).[34,96]

Additional support for a climate-switch to a global cooling phase is evident by comparing the temperature declines after the climate optimum of all glacial cycles in the last 800,000 years in Antarctica and two million years globally. This analysis shows this current ice age inception is the slowest to decline in temperature **compared with all other glacial cycles** in 800,000 years (Antarctica) and two million years (Global). Antarctica's current ice core temperature is 3.1°C higher than the average 10,500 years after the Antarctic climate optimum. Similarly, the current global temperature is 1.26°C higher than the average 2,100 years after the global climate optimum. If the climate system reverted to the glacial cycle mean, then **we are in for a cold surprise**. Just to clarify, this slow declining temperature trajectory after the Holocene Climate Optimum long preceded significant human greenhouse gas emissions (see slide deck #5).[97,98]

Catastrophic natural climate change risks were dismissed or omitted from AR5s key-risk assessment (incriminating disclosures follow)

The two sections above provide a post-Holocene Climate Optimum (i.e., ice age inception) and an ice age re-entry (i.e., a climate switch back to a cooling phase) context for the natural climate change risks that we will face this century. This context then gives perspective on AR5's key-risk assessment that promotes hypothetical climate change risks caused by theoretical anthropogenic global warming.[9-12] Strikingly, there was a **lack of historical climate data** used in AR5 to support the IPCC's key-risk assessment. Instead, the reader is bamboozled by discussions on theoretical concepts like climate system thresholds and tipping-points and hypothetical climate change risks.

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This biased IPCC key-risk assessment comes at a price—the dismissal, omission, and veiling of catastrophic natural climate change risks most relevant to the 21st century, and in plentiful evidence since the Arctic's Holocene Climate Optimum (HCO) eight millennia ago and especially during the Little Ice Age (mid-13th to mid-19th centuries), i.e., global and regional cooling cycles, glaciation, climate-forcing volcanism, rapid climate change, grand solar minimum related extremes of precipitation, and pandemic influenza.

THE LITTLE ICE AGE'S CATASTROPHIC IMPACT WAS DOWNPLAYED: A keyword search of AR5's suite of five documents reveals 61 instances mentioning the "Little Ice Age (LIA)." Twenty-five mentions were associated with end of chapter citations, and 11 were associated with annotations. The most pertinent of all of the remaining LIA mentions **dismissed the relevance** of historical large-scale climate change and society upheavals in today's world without good reason, "*it should be noted that these findings from historical antecedents are not directly transferable to the contemporary globalized world.*"[99]

Worse still, WG1 tell us that solar and volcanic forcings ***"contributed substantially"*** to the LIA's climate change, such as its cold, snow, mega-droughts and high rainfall periods.[100] Despite knowing of this substantial solar and volcanic activity contribution to the LIA's climate change the IPCC conveniently omitted secular changes in solar activity (i.e., this grand solar minimum period) and volcanic forcing from its climate forecasts [13] (i.e., **eliminating potent cooling factors**) and key-risk assessment [9-12,189,195] (i.e., eliminating **catastrophic natural climate change risks**). The LIA comprised four well-known grand solar minimum periods[101] and eleven large magnitude Volcanic Explosivity Index 6-7 volcanic eruptions (see slide deck #12) and a raft of smaller climate-forcing VEI 4-5 eruptions.[102]

My review of the literature indicates the strongest cooling impact during the Little Ice Age occurred in the North Atlantic and the northern latitudes of Europe, Asia, and North America. By contrast, there was either more droughts or more rainfall at the lower latitudes, which was atmospheric circulation and monsoon system dependent. In each region differing climate and precipitation extremes were associated, and/or correlated, with the LIA's numerous grand **solar minima periods**. The various LIA citations for Europe,[103,104,105,106,107,108] North America,[109,110] China,[111,112,113,114,115,116] India,[117,118,119,120] Africa, [121, 122, 123, 124] South America, [125, 126, 127, 128] Caribbean and the Yucatan Peninsula,[129,130,131,132] provide you the regionally specific climate change facts that were omitted in AR5.

Crucially, there is no mention, emphasis, or quantification in the AR5 of the widespread human catastrophes associated with the LIA's successive and prolonged periods of cold and climate extremes. For example, in China, war outbreaks, major epidemics, and population collapses were significantly correlated or associated with extreme climate change and cold periods.[133,134] China lost nearly half of its population through successive climate-related famines, epidemics, and wars during the 13th and 14th centuries.[135] The Great Famine of 1315–1317 was also the worst prolonged famine in Europe's history, leading to large-scale mortality (10 percent).[136] Three decades later Europe was ravaged

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once again, losing one-third of its population due to the Black Plague, social unrest, and economic hardship.[137,138] These high mortality events in China and Europe took place during the Wolf minimum (1280-1350), and in the decades after the current era's largest volcanic explosion (Rinjani, Indonesia, in 1257).

Fast-forwarding to the 17th century, during the longest and coldest phase of the LIA associated with successive catastrophes, Europe's population suffered from high mortality rates (the General Crisis[139]), while China lost nearly half its population once again,[140,141] from famine, disease, and wars. These catastrophes occurred during the Maunder minimum (1645-1715), the deepest and longest solar activity trough of the Little Ice Age.

The **undismissable lesson** from the Little Ice Age that is highly **relevant in today's world** is that cold phases and drought severely impacted agricultural production yields, leading to rising food prices, malnutrition, and **famines**. These in turn, along with other important contributing factors, led to epidemics, social unrest, revolutions, and wars.[142] No matter how much technological progress our modern society has made, crops and livestock are still vulnerable to severe changes in the weather. Just to remind you, between late 2006 and 2008 regional crop failures occurred among major food exporters due to drought, and this snowballed into a global food crisis severely impacting many nations.[143,144,145,146,147] This recent food crisis demonstrated how fragile our modern agricultural system and global food supply are.

RAPID CLIMATE CHANGE RISKS WERE DISMISSED: Working Group 1 **only** reviewed hypothetical abrupt or rapid climate change risks relevant to theoretical anthropogenic global warming. The IPCC **dismissed the prospect** of near term abrupt climate change by telling us, "*The likelihood of such changes is generally lower for the near term than for the long term*" (without explaining that assumption).[148] This near-term dismissal was then used to focus our attention on hypothetical long-term abrupt climate change risks, which were then dismissed and/or were irrelevant to our stage of the glacial cycle. A small number of catastrophic rapid climate change risks **linked only to global warming** were then reviewed (i.e., Atlantic Meridional Overturning Circulation or AMOC collapse, Dansgaard-Oeschger and Heinrich events, and abrupt methane release from clathrates), but their prospect was dismissed (see next). Critically, **no abrupt climate change risks appear in the IPCC's promoted key-risks**.[9-11]

Working Group 1 reviewed and then dismissed the theoretical prospect of abrupt methane release during the 21st century from land and oceanic clathrate sources due to anthropogenic global warming.[149,150] Catastrophic methane release last occurred during the Paleocene-Eocene thermal maximum about 55 million years ago,[151] when global temperatures were twice as high as today's ice age epoch climate trough and when no polar ice caps existed (i.e., *this page-filling detail is irrelevant to the post-Holocene Climate Optimum period, or to the Holocene interglacial period as the IPCC assume*).

Working Group 1 and 2 erroneously tell us, "*The most prominent abrupt climate change periods in the recent geological record, developing within 10 to 100 years, are associated with Dansgaard-Oeschger and Heinrich events (WGI AR5 Section 5.7), which occurred*

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repetitively during the last 120 kyr."[152,153] These events occur after the Arctic ice cap has already formed in the depths of an ice age (i.e., *this page-filling detail is irrelevant to the post-Holocene Climate Optimum period, or to the Holocene interglacial period as the IPCC assume*).

In reality, **the most prominent** abrupt or rapid climate change events or periods in the recent geological record (i.e., since just before the Holocene Climate Optimum), developing within 10 to 100 years, were the *Younger Dryas*, the 8.2, 5.9, and 4.2 kiloyear *rapid climate change events* (among other events), the *Little Ice Age*, and the multitude of *climate-forcing volcanic eruptions* (<-5W/m^2 radiative forcing impact or VEI 6-7) that impacted climate change within one year (i.e., Rinjani 1257CE, Tambora 1815CE, Laki 1783CE etc., see below).

A keyword search of AR5's five documents reveals 61 instances mentioning abrupt climate change (ACC) and 44 instances mentioning rapid climate change (RCC). The vast majority of ACC/RCC mentions relate to end of chapter citations, with a minority of mentions linked to **theoretical** discussions on global warming. One ACC mention was associated with the 8.2Kyr rapid climate change event, linked to a theoretical discussion on Atlantic Meridional Overturning Circulation recovery times (i.e., *its recovery after a catastrophic rapid cooling event*; see Younger Dryas discussion below).[154] The only mention of ACC/RCC risks in the context of risk-mitigation were linked to theoretical risks associated with geoengineering anthropogenic global warming.[155]

Well-known ACC/RCC events that took place since just before Greenland's Holocene Climate Optimum are highly relevant to our 21st century natural climate change context. In summary, these RCC events were characterized by abrupt (i.e., annual to decadal) and sustained (i.e., over centuries) cooling periods in the Poles, which reverberated globally. The worst two RCC events saw the Arctic ice core temperatures decline by 3.35°C (8.2Kyr[156]) and 9°C (Younger Dryas[157]), and were associated with significant ice sheet expansions and regional cooling of between 3°C and 6°C. Droughts and desertification also intensified across Northern Africa, the Middle East, parts of Asia, and the tropics. Some of these RCC events and their catastrophic impact on ancient societies are cited, including the 8.2 kiloyear,[158,159,160,161] the 5.9Kyr,[162] and the 4.2Kyr events[163,164,165166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181] (multiple citations review the varying geographical and societal impacts).

One of the most catastrophic rapid climate change events of the Holocene interglacial period was the Younger Dryas (12,900-11,700 YBP). The broader Dryas period witnessed an overall decline of 18.4°C in Greenland's ice core temperature from about 14.5 kiloyears ago, and at its terminal phase the Arctic ice core temperature plunged by 9°C within three centuries (i.e., Younger Dryas), while the Arctic ice sheets advanced.[157,182] The Younger Dryas was associated with the worst extinctions of the Holocene interglacial, including dozens of mammalian and avian species.[183,184] The human species was also majorly curtailed in affected regions, with humans being forced to migrate to survive.[185] How will the world cope with **the need to *move tens of millions of people*** if such an event took place during this current grand solar minimum period?

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AR5s suite of five documents mentioned the Younger Dryas (YD) ten times. Three YD mentions focus our attention on the rate of regional warming in the recovery phase of the YD (allegedly comparable to all four RCP global warming scenarios). This warming phase focus was done at the expense *of reviewing the rapid cooling* that was associated with **numerous mammalian species extinctions**.[186] One other significant mention of the YD was to **dismiss the prospect** of a 21st century Atlantic Meridional Overturning Circulation (AMOC, or Arctic–Atlantic thermohaline circulation) weakening linked to anthropogenic global warming.[187]

On the subject of an AMOC collapse, as an example of ACC/RCC described by the IPCC, AR5 documents mentioned 218 instances of AMOC. The vast majority of AMOC mentions focused on global warming and theoretical model simulations supporting the IPCC's conclusion, "*It is very unlikely that the AMOC will undergo an abrupt transition or collapse in the 21st century for the scenarios considered (high confidence)"* (i.e., for the IPCC's four RCP global warming scenarios).[188] Working Group 1 also dismissed the prospect of a northern hemisphere cooling resulting from a strong AMOC reduction, under all four RCP warming scenarios. This AMOC-linked cooling dismissal was counter to the IPCC's FIO-ESM modeled outputs[188] and the historical data defining numerous periods of centennial-scale ice rafting that were associated with prolonged periods of low solar activity during the last 11,400 years (See the paragraph associated with endnote[290]). This FIO-ESM AMOC-linked cooling dismissal was also made in the full knowledge that significant radiative forcing cooling factors (i.e., solar activity and volcanic forcings) were excluded from the IPCC's global temperature forecasts.[13,189,195]

The climate change impact of secular changes in solar activity (i.e., irradiance **and** magnetized solar wind) and climate-forcing volcanism on abrupt AMOC changes was also omitted from the IPCC's discussion on abrupt AMOC weakening or collapse. This omission was made despite the IPCC telling us that stratospheric processes, the North Atlantic Oscillation, sea surface temperatures, sea ice, and external forcing (i.e., solar activity, volcanism) can lead to atmospheric blocking associated with AMOC changes.[190] The scientific literature details the important role of solar activity, grand solar minimum periods, and climate forcing volcanism on Arctic glaciation mechanisms and climate change.[191,192,193,271-289] The above described biased dismissal of an AMOC collapse was also made with WG1's full knowledge of the *significant limitations of the* CMIP5 *models* to simulate post-volcanic radiative and dynamic responses.[194]

CLIMATE-FORCING VOLCANISM WAS OMITTED FROM THE KEY-RISKS:
While it is clear the IPCC recognizes that volcanic activity can have a dramatic impact on the global climate (i.e., cooling),[100] crucially the IPCC's climate forecasts[13] and promoted key-risks[9-11] **do not include** the occurrence of climate-forcing volcanic eruptions. We are told, "*The future projections in this report do not include future volcanic eruptions*," and "*the RCP scenarios assume no underlying trend in total solar irradiance and no future volcanic eruptions. Future volcanic eruptions cannot be predicted and there is low confidence in projected changes in solar irradiance. Consequently the possible effects of future changes in natural forcings are excluded from the assessment here*."[195]

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The IPCC's opinion that "*volcanic eruptions cannot be predicted*" is no less true than inaccurately forecasting the climate for three decades in support of dangerous policies and regulations.[196,197] That said, we know three of the last seven Holocene VEI 7 eruptions and approximately one-quarter of all VEI 6 eruptions from the last 11,400 years have taken place since 942 CE. We also know the century averages of VEI 4, 5, 6, and 7 eruptions from the last millennia, which could be extrapolated to crudely predict the 21st century climate-forcing volcanism risk.[198] This crude extrapolation would be in preference to the IPCC conveniently rejecting volcanism's forecastability, just to eliminate cooling contestation to its biased key-risk assessment and four RCP scenarios.

Adding further specificity to predicting 21st century VEI 4-7 eruptions beyond simply extrapolating century-rates of eruptions, we know (i.e., by analyzing historical data) the majority of the Holocene and Little Ice Age's large-magnitude volcanic eruptions occurred at grand solar minima and maxima of sunspot numbers (see slide deck #11-12).[199,200,201,202] This slide deck #11-12 depicted data indicates that grand solar minima and maxima of sunspot numbers represent high-risk periods for climate-forcing volcanism, linked to a magnetized solar wind mechanism.[203]

Scientists believe that if a VEI 7 eruption were to occur today, such an event would likely come from volcanoes located in tectonic plate subduction zones.[204] Based on historical eruption frequencies we know the majority of the world's volcanic eruption risk is concentrated in just six countries (i.e., Indonesia, Philippines, Japan, Mexico, Ethiopia and Guatemala).[205] This preceding information makes it is possible to predict 21st century climate-forcing volcanism risk and to develop a **global risk-mitigation plan**.

Just to remind you, climate-forcing volcanism was periodically catastrophic after the Holocene Climate Optimum, and during the Little Ice Age (LIA).[206,207,208,209,210] In fact, a large magnitude volcanic eruption is believed to have triggered the Little Ice Age (Rinjani in 1257, a VEI 7 eruption, associated with a grand solar maximum of sunspot numbers),[211] which was then followed by other large magnitude volcanic eruptions (VEI 4-5), roughly one every decade. These eruptions collectively resulted in volcanic sulfate levels during the 13th century that were many times greater than in any other century during the last millennia. The resulting cold periods had a catastrophic impact on the climate that was sustained over centennial time scales, and long after the eruptions' volcanic aerosols were cleared from the stratosphere.[212,213,214,215,216]

The Rinjani eruption was associated with climate disruptions in Europe and Eurasia in the following years, causing cold winters and summers, and severe flooding. This led to grain shortages, food price inflation, and famines associated with high mortality over the ensuing years to decades.[217,218,219] Similarly, Tambora (i.e., 1815 CE, a VEI 7 eruption during the Dalton minimum) caused disastrous crop failures across the northern hemisphere the following year. The year 1816 was dubbed the "*year without a summer*." This also led to widespread famine, social unrest, and caused a major human death toll in Europe, Asia, and North America.[220,221,222]

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Since AR5's publication, scientists indicate that a repeat of a Laki-like volcanic eruption (Iceland, 1783) would wipe out *one year's worth of food for one-third of the world's population*.[223] The only AR5 risk-mitigation discussion associated with climate-forcing volcanism was linked to the inane idea of using artificial stratospheric aerosol injections to counter theoretical anthropogenic global warming.[224] There is **no mention** of our need to mitigate the risks of climate-forcing volcanism on world energy supplies and solar photovoltaic and solar concentrating power systems, or on climate-adapting our global agriculture, bolstering food stockpiles and emergency food production capabilities, readying cold-adapted crop seed banks and farming systems, improving global food supply resilience, or ensuring sustainable water supply in drought-prone regions.

GRAND SOLAR MINIMUM RELATED CLIMATE RISKS WERE DISMISSED: There is no mention in AR5 documents of the global cooling predictions published by scientists expert in solar activity driven climate change, linked to this current grand solar minimum period. These **experts warn us** in a consensus-like manner of a return to Little Ice Age-like conditions during this grand solar minimum (2020-2060 CE).[225,226,227,228,229,230,231,232]

Despite the wealth of scientific literature detailing the regional climate change and risk impact of grand solar minimum periods during the LIA,[103-141] the IPCC only mentioned grand solar minimum twice in all AR5 documents. These mentions were to dismiss its prospect and its impact on 21st century climate change. Despite **only two mentions of grand solar minimum** associated with the following quotes, "*the most recent solar minimum was the lowest and longest since 1920*," and "*if there is such a reduction in solar activity*," WG1 had a "*low confidence"* in expert projections of a much quieter sun in the decades ahead, and a "*high confidence that the variations in TSI RF* (i.e., total solar irradiance radiative forcing) *will be much smaller than the projected increased forcing due to GHGs* (i.e., greenhouse gases).[233]

According to the IPCC's non-natural version of the climate system, solar irradiance accounted for about two-percent (0.05 Watt/m^2) of the total annual radiative forcing (RF) change relative to 1750, which is the same RF impact it assigned to contrails, while anthropogenic forcing putatively accounted for 98% of the RF impact.[234] By contrast, the solar activity expert and director of the Max Planck Institute for Solar System Research informs us that solar activity vary more significantly[235] than the IPCC assumed.[236] Since the Maunder minimum (1645-1715 CE), and with shorter-term fluctuations over the 11-year solar cycle, solar irradiance has varied by 2-4 Watts/m^2,[235] which is broadly the same as the putative radiative forcing impact of anthropogenic greenhouse gases.[237] This Max Planck Institute expert on solar activity casts doubt on the IPCC's assumptions on solar irradiance during this grand solar minimum period. The IPCC also **completely ignored** the climate change impact of magnetized solar wind on climate change.[270,290]

Since 1990 the IPCC failed to detail the full extent of **solar activity's impact on climate change**, via both electromagnetic **and** magnetic mechanisms. According to the literature, the sun connects to the natural climate system via solar irradiance (electromagnetism), which has an immediate impact on radiative forcing (i.e., only this impact is considered by

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the IPCC) and a delayed impact on climate change[270] putatively via changes in ocean circulations and heat content, among other mechanisms linked to ionizing radiation. Secondly magnetized solar wind (magnetism) impacts the climate system by connecting with earth's magnetosphere (i.e., its magnetic shield), which impacts geomagnetism and earth's rate of rotation,[238,239,240,241,242] which ultimately connects with atmospheric and ocean circulations to impact the climate (i.e., a delayed effect).[243,244,245,246,247,248,249,250,251,252,253,254,255] Thirdly, solar activity-induced changes to solar wind impact geomagnetism and earth's rate of rotation (i.e., angular momentum), which impact tectonic processes and therefore climate-forcing volcanism (and earthquakes).[256,257,258,259,260,261,262,263,264,265,266,267,268]

In reflecting the above paragraph's literature citations, and with some data analysis, it becomes clear that a significant correlation exists between the northern hemisphere temperature and an 18-year moving average (mav) Beryllium-10 concentration anomaly (i.e., a proxy for magnetized solar wind[269]) since 1400 CE.[270] The temperature and mav-Beryllium-10 concentration anomalies vary inversely on multi-annual, multi-decadal, and multi-centennial time scales, unlike the atmospheric CO2 concentration. The correlation coefficients also strengthen during grand solar minimum and maximum periods (see slide deck #8 and #10). This data unequivocally shows that **cold climates always follow** the sun's decline in magnetic activity during **grand solar minimum periods**.

Importantly, prior to AR5's release in 2014,[271,272,273] and subsequently,[274,275] the science has emerged to define a putative multi-decadal- to centennial-scale Arctic glaciation mechanism that operated in the Arctic-North Atlantic during the Little Ice Age. This glaciation mechanism was linked to secular changes in solar activity (i.e., grand solar minimum periods), climate-forcing volcanism, Arctic sea ice exports entering the sub-polar North Atlantic region, and changes to Arctic-Atlantic ocean and sea circulations that reduced warm water entry into the Arctic region.

Climate-forcing volcanism, and a prolonged negative phase of the North Atlantic Oscillation, which is a key determinant of the winter climate over the North Atlantic[276,277,278,279,280,281] were instrumental in this glaciation mechanism.[282,283] The North Atlantic Oscillation is coupled to the magnetosphere and stratosphere by some complex physical processes,[284,285] and its phase and strength are correlated with geomagnetic activity, which is modified by magnetized solar wind.[286,287,288] The North Atlantic Oscillation is also modified by changes in stratospheric volcanic aerosol levels.[289]

Casting further doubt on the IPCC's dismissal of AMOC weakening associated with rapid climate change, and putatively linked to the above-described Little Ice Age glaciation mechanism, is that secular changes in solar activity were significantly correlated with centennial-scale drift ice changes over the last 11,400 years. Virtually every centennial-scale increase in drift ice during the last eleven millennia was associated with sustained periods of low solar activity. Ice rafting reflects an increased discharge of icebergs from Arctic glaciers, while the debris reflects the iceberg melting after transportation eastward from the Labrador Sea and southward from the Nordic Seas. Therefore the Arctic-Nordic Seas represent a key region where solar-induced atmospheric changes are amplified and

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transmitted globally through their impact on sea ice and the North Atlantic thermohaline circulation or AMOC (see slide deck #7).[290]

RISK-MITIGATION IMPLICATIONS: The risk-mitigation implications of the above sections are obvious; **(1)** this current grand solar minimum period and climate-forcing volcanism risks have not been reflected in the IPCC's key-risk assessment (i.e., global cooling, regional extremes of precipitation, Arctic glaciation, and rapid climate change) or its climate forecasts (i.e., global and regional cooling, and regional precipitation extremes). **(2)** Climate change *risk-mitigation advice must be unshackled* from its UNFCCC Article 1 and 2 constraints and be regionally bespoked, based on the Little Ice Age, rapid climate change, and climate-forcing volcanic eruption precedents.

Grand solar minimum periods portend increased pandemic influenza risk, while WHO's pandemic flu vaccine strategy leaves us vulnerable

Unbeknown to mainstream science is the observation that grand solar minimum associated Arctic cold-glaciation periods pose **increased pandemic influenza risk**. Pandemic influenza outbreaks[291] demonstrate a high frequency of association with: **(A)** peaks and troughs (±1 year) of the 11-year solar cycle, which is embedded in numerous solar activity related parameters,[292,293,294,(295)] **(B)** specific thresholds of solar activity- and climate-related proxies and indices,[292,293, 296 , 297 , 298 , 299 , 300] while **(C)** numerous significant correlations (r ±0.94-to-1.00, P-value <0.05) are evident between the number of pandemics per century and/or the average pandemic interval per century through the Little Ice Age, and the prior cited solar activity and climate change proxies.[292-300,301]

This current grand solar minimum period represents a **high-alert** situation, but our perception of pandemic risk is undermined by the IPCC's projected 21st century global warming, its dismissal of solar activity's control of natural climate change, and its erroneous delay of the ice age. With highly pathogenic avian H5N1 and H7N9 influenza strains (among others) continuing their mutation and animal-to-human infections,[302] and killing between 25 and 50% of infected humans,[303,304,305,306,307] we should be **very concerned** about a pandemic influenza outbreak in the years and decades ahead.

Making matters worse, another United Nations entity, World Health Organization (WHO), presides over an obsolete (70 years old) global influenza strategy for pandemic influenza ("strategy").[308] This strategy fails to reflect the recommendations made by the vaccine industry and key opinion leaders to implement prepandemic immunization in the wake of the 2009 swine influenza pandemic,[309,310] and fails to reflect the tremendous technological progress made by the vaccine industry with oil-in-water adjuvants and prepandemic immunization.[311,312,313,314,315,316,317,318,319] This WHO-promoted global strategy leaves the world immunologically vulnerable to a pandemic caused by H5, H7, H9, H2, and other influenza-A strains, sub-types and mutants, **when this need not be the case**.

Since the 2009 swine influenza pandemic, vaccine technology advances make it possible to immunize people before a pandemic peaks in mortality (i.e., via prepandemic immunization). Prepandemic immunization would use vaccines composed of an oil-in-

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water adjuvant and pandemic-related influenza vaccine antigens from high-risk strains (i.e., hemagglutinin, H; H5, H7, H9, H2, other). Such vaccines promote broadly cross-reactive neutralizing antibody responses to conserved parts of the hemagglutinin antigen (i.e., hemagglutinin-stem Bcell epitopes[309-319]).

Prepandemic immunization would offer government healthcare providers a vaccine **counter-strategy to viral mutation**, because hemagglutinin-stem Bcell epitopes mutate much less frequently than the hemagglutinin-globular heads targeted by vaccines without an adjuvant. This means prepandemic immunization could immunologically target a broader repertoire of viral sub-types and emerging viral mutants not specifically immunized against. Broadly cross-reactive antibody memory responses can be boosted at flexible intervals of up to six years by vaccines composed of different viral sub-types (mutants)([309-319]). This means governments could stockpile immunity in the population for much longer than it can stockpile vaccines in cold storage.

Despite the vaccine industry's technological and clinical progress with prepandemic immunization feasibility, all we've done since the emergence of highly pathogenic avian H5N1 virus in 2005 is effectively tackle the vaccine problem from one end. To this end, industry has greatly expanded global influenza vaccine manufacturing capacity, continues its transition to larger-scale production methods, while reducing the timeline for vaccine batch release.[320,321,322,323] However, we still **remain confined to an obsolete WHO-led strategy** that recommends the manufacture of a pandemic flu vaccine after a pandemic outbreak, rather than beforehand. This forces governments' **reliance on advanced purchase contracts** that will have little chance of being fulfilled before a pandemic peaks in mortality.

Given 2009's swine influenza pandemic vaccine supply debacle, WHO is aware that population immunity cannot be equitably achieved before a pandemic peaks in mortality under their vaccine strategy.[324, 325, 326, 327] Under this WHO-led strategy vaccine manufacturers will be unable to provide two vaccine doses (a prime and booster) per person before a pandemic peaks,[328,329] irrespective of global manufacturing capacity. This is because the lead-time to a pandemic flu vaccine's first marketing approval is broadly the same as the time to a pandemic's peak incidence and mortality,[330,331] never mind the additional time required to reach full-scale vaccine production.

Compounding the above problem still further is that unless pandemic influenza vaccines are supplied by Sequirus or GlaxoSmithKline (i.e., containing an oil-in-water adjuvant), at least half the pandemic influenza vaccine supply will rely on the existing seasonal flu vaccine technology without an adjuvant. These non-adjuvanted vaccines are only 60 percent effective at preventing mild forms of seasonal influenza,[332] never mind a highly pathogenic virus, and are rendered largely ineffective by viral mutation.[333,334] This means pandemic influenza vaccines without an adjuvant will be rendered much less effective against the second and third waves of viral attack by post-pandemic viral mutants. In the 1918 and 1957 influenza pandemics, the second and third waves of viral attack were more severe than the first wave.[335,336,337]

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Despite all the above shortcomings, the only substantive change made since 2009 to broadening the scope of protection against influenza-A and B strains as a group threat (i.e., seasonal and pandemic influenza), which was recommended by WHO, has been moving from a three-component (trivalent) to a four-component (quadrivalent) seasonal flu vaccine, by adding a second influenza-B strain.[338,339] While this solved the B-strain vaccine efficacy issue and expanded global manufacturing capacity for use in a pandemic outbreak (from manufacturing three to four vaccine components i.e., a 33 percent increase), it still left humanity fully vulnerable to highly pathogenic pandemic flu threats.

Please read *Revolution: Ice Age Re-Entry* Chapter 14[340] for vaccine solutions to this problem using the existing flu vaccine technologies and regulatory approval pathways.

The AGW marketing communications strategy (marcoms) is poorly effective at motivating an energy system switch

Given this UNFCCC Article 1 and 2-enabled corruption of climate science and the IPCC's dismissal-omission of catastrophic natural climate change risks relevant to the 21st century, there is a strong justification for refuting the UN/IPCC's Article 1- and 2-dictated key-risk assessment.

This justification is further augmented when you consider this corruption-enabled AGW-marcoms is also **poorly effective at switching the world's energy system** ("strategy"). This ineffectiveness is evidenced by the low single-digit market share for non-hydroelectric renewables in the world's primary energy mix and its modest 10-year compound annual growth rate,[341] despite decades of effort and trillions of investment and subsidy dollars. Atmospheric CO2's unabated rise, while many nations expand their coal use, further highlights the strategic ineffectiveness of the United Nations strategy.

Lurking beneath this AGW sham-science is **another grand deception**. The world only has about fifty years 'proven' oil and gas reserves left (AR4-5 WG3[342,343]).[344] If you think we will discover more oil and gas, then reflect that global annual reserves-to-production has been less than 100% for most of the last forty years (see slide deck #24-25). This confirms expert and market commentator opinions that peak oil and gas discovery is history.[345,346,347,348,349] Moreover, the highly guesstimated and overstated nature of 'unproven' oil and gas reserves,[350,351] combined with the above, means that our perception of energy scarcity has been eliminated.

This obfuscation of oil and gas reserves ensures our continued profligate use of these limited resources. This obfuscation **eliminates a powerful economic incentive** (i.e., higher oil and gas prices) for switching energy systems, while hypocritically failing to respect the principles of sustainable development i.e., permitting tomorrow's generations to meet their needs (in a much colder world).

The world needs a new climate change theory to support our essential energy system switch and sustainable development goals, which galvanizes a global sense of unity and commitment to act with urgency. Our ice age re-entry predicament and its associated

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catastrophic risks, and limited proven oil and gas reserves will be far more effective at achieving a unified commitment to act with urgency than this IPCC-led sham-science lie.

Preventable strategic genocide

In summary, the **United Nations presides over two global strategies** meant to protect humanity against catastrophic natural climate change and related risks. In the event of a natural climate change catastrophe and/or a pandemic influenza outbreak, this UNFCCC Article 1 and 2-led corruption, and WHO-led global influenza vaccine strategy[308] could lead to **strategic genocide,** because catastrophic risks were left unmitigated by dubious global strategies. This potential for strategic genocide will majorly impact the developing and northern nations, the world's poor and city dwelling, and those nations without a pandemic influenza vaccine production capability that are reliant on advanced purchase contracts (i.e., New Zealand, and most other countries).

Yours sincerely

Dr. Carlton Brown BVSc (Massey University, NZ) MBA (London Business School)

Advocate for Natural Climate Change Risk-Mitigation: Switching to Renewable Energy, and Implementing Centralized/Decentralized Sustainable Development and Prepandemic Influenza Immunization (**Urgently**)
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Endnote Citations and incriminating IPCC Disclosures (Quotes)

1 Thomas S. Kuhn, The Structure of Scientific Revolutions. Second Edition, Enlarged. International Encyclopedia of Unified Science. © 1962, 1970 by The University of Chicago. All rights reserved. Published 1962. Second Edition, enlarged, 1970.

2 **A restricted definition of climate change and its risk-mitigation were enforced by UNFCCC Articles 1 and 2** (blaming and reducing human greenhouse gas emissions). United Nations Framework Convention on Climate Change. United Nations 1992. FCCC/INFORMAL/84, GE.05-62220 (E), 200705. [See page 3 and 4 for Article 1 and 2 definitions. **Article 1 definition**: "*Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.*" **Article 2 objective**: "*The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic*

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interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner." NB: This definition for climate change was present at the IPCC's 1988 founding. In other words, the science of climate change was predetermined (human activity, greenhouse gases) and had nothing to do with an international scientific consensus (other than via carefully selected or politically aligned government scientists provided by UN member state governments). Article 2's objective is focused on stabilizing atmospheric greenhouse gases at levels that would prevent dangerous human interference with the climate system. In other words, in 1988 Article 2 had already determined that human activity was dangerous and that it needed to be mitigated.].

3 **The radiative forcing theory was installed in 1988 by UNFCCC Articles 1 and 2.** Climate Change: The IPCC Scientific Assessment (1990). Report prepared for Intergovernmental Panel on Climate Change by Working Group 1. J.T. Houghton, G.J. Jenkins and J.J. Ephraums (eds.). Cambridge University Press, Cambridge, Great Britain, New York, NY, USA and Melbourne, Australia 410 pages [See the Preface's Introduction. "*The Intergovernmental Panel on Climate Change (IPCC) was jointly established by our two organizations in 1988. Under the chairmanship of Professor Bert Bolin, the Panel was charged with: assessing the scientific information that is related to the various components of the climate change issue, such as emissions of major greenhouse gases and modification of the Earth's radiation balance resulting therefrom, and that needed to enable the environmental and socio-economic consequences of climate change to be evaluated, (ii) formulating realistic response strategies for the management of the climate change issue*." NB: this confirms the bias in the IPCC's scientific assessment in its first scientific assessment in 1990, and that the radiative forcing theory was predetermined from the IPCC's outset.].

4 **InterAcademy Council confirms the IPCC's scientific bias and its bias-enabling procedures.** Climate Change Assessments. Review of the processes and procedures of the IPCC. October 2010. Committee Review of the Intergovernmental Panel on Climate Change. Report available at http://reviewipcc.interacademycouncil.net/. [Page 18; **Critiquing the IPCC's "confirmation bias."** Page 14; Government provided a list of politically aligned scientists. We are told that governments do not always put forward the names of the best climate scientist volunteers for the IPCC work. Political considerations are prioritized over scientific expertise and qualifications in the IPCC scientist selection process. Page 14; **"Author selection" enables scientific bias.** Co-chairs select lead and coordinating authors from a list of nominees provided by governments. Page 21; **lack of independent review of AR1-4 arises** because the working group co-chairs also select the review editors. Page 23; final synthesis reports are **not written by independent expert scientists**, but result from negotiations among government representatives and the IPCC chair and working group co-chairs. Page 24; **line-by-line negotiation results in differences** between the assessment reports and the final politicized synthesis report provided to governments.].

5 **The principles governing IPCC work and that enable its scientific bias**: Appendix A: Procedures for the preparation, review, acceptance, adoption, approval and publication of IPCC Reports. https://www.ipcc.ch/site/assets/uploads/2018/09/ipcc-principles-appendix-a-final.pdf.

6 **The IPCC confirms its scientific bias (1).** Climate Change: The IPCC Scientific Assessment (1990). Report prepared for Intergovernmental Panel on Climate Change by Working Group 1. J.T. Houghton, G.J. Jenkins and J.J. Ephraums (eds.). Cambridge University Press, Cambridge, Great Britain, New York, NY, USA and Melbourne, Australia 410 pages. [See the Preface, "*The result is the most authoritative and strongly supported statement on climate change made by the international scientific community. The issues confronted with full rigor include: global warming, greenhouse gases, the greenhouse effect, sea level changes, forcing of climate, and the history of Earth's changing climate.*" **NB:** i.e., there is no mention of the other climate science sub-fields linked to natural climate change.].

7 **The IPCC confirms its scientific bias (2).** IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. [See the Preface Page vii. "*The Working Group I report focuses on those aspects of the current understanding of the physical science of climate change that are judged to be*

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most relevant to policymakers. *It* ***does not attempt to review the evolution of scientific understanding or to cover all of climate science***." **NB:** this confirms its scientific bias.].

8 **The IPCC confirms its scientific bias (3).** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See the Preface page vii, "*Underlying all aspects of the report is a strong commitment to assessing the science comprehensively,* ***without bias and in a way that is relevant to policy*** *but not policy prescriptive*," and "*Focused on those aspects of the current understanding of the science of climate change that were judged to be most relevant to policymakers*." **NB:** confirming the IPCC's bias directly (i.e., relevant to policy makers) and indirectly (i.e., manipulatively telling us "without bias," which is diversionary). See page 661 Chapter 8, Executive Summary. *"As in previous IPCC assessments, the fifth assessment report uses the radiative forcing (RF) concept, but it also introduces effective radiative forcing (ERF)*." **NB:** without reflecting the tremendous progress made by other climate science sub-fields].

9 **WG2 tell us the climate key risks are <u>only</u> those relevant to UNFCCC Article 2 (i.e., anthropogenic global warming).** IPCC, Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pages [See page 11 and 59, Section B-1. Key Risks across Sectors and Regions, "***Key risks are potentially severe impacts relevant to Article 2 of the United Nations Framework Convention on Climate Change, which refers to "dangerous anthropogenic interference with the climate system****."* See page 64, "*Table TS.4, Climate-related drivers of impacts:* ***Warming trend, extreme temperature, drying trend, extreme precipitation, damaging cyclone, flooding, storm surge, ocean acidification.***" See page 11. *Risks are considered key due to high hazard or high vulnerability of societies and systems exposed, or both. Identification of key risks was based on expert judgment using the following specific criteria:*" (**NB**: expert judgment = bias). See page 12, "*The key risks that follow, all of which are identified with high confidence, span sectors and regions*. (NB: all risks are **associated with global warming**)." See page 13 for the risks linked to anthropogenic global warming i.e., sea level rise and flooding, extreme weather events, food and water insecurity, and loss of biodiversity. See page 14. "*Increasing magnitudes of warming increase the likelihood of severe, pervasive, and irreversible impacts. Some risks of climate change are considerable at 1 or 2°C above preindustrial levels (as shown in Assessment Box SPM.1). Global climate change risks are high to very high with global mean temperature increase of 4°C or more above preindustrial levels in all reasons for concern (Assessment Box SPM.1).*" See pages 59-65 for the IPCC's projected key-risks; climate-related drivers of impacts, hazards, and reasons for concern, associated **only with anthropogenic global warming**. See page Box TS.3 on page 59. "*Sea level rise and coastal flooding including storm surges; Extreme precipitation and inland flooding; Increasing frequency and intensity of extreme heat, including urban heat island effect; Warming, drought, and precipitation variability; Drought; Rising ocean temperature, ocean acidification, and loss of Arctic sea ice; Rising land temperatures, and changes in precipitation patterns and in frequency and intensity of extreme heat."* **Among the worst consequences** were the*, "Risk of mortality and morbidity during periods of extreme heat; Risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding, and precipitation variability and extremes, particularly for poorer populations in urban and rural settings; Increased risk of species extinction* (NB: humans not mentioned)*; Violent conflict.*" See page 59, "***Key risks are integrated into five complementary and overarching reasons for concern*** *(RFCs) in Box TS.5*." See page 61, "*They (i.e., RFCs) provide one starting point for evaluating dangerous anthropogenic interference with the climate system*." All RFC's are **linked to elevated temperatures**. See page 63 Box TS.6 **| Consequences of Large Temperature Increase** (See the Refutation's section on Rapid Climate Change for detail on this) The worst of it includes, "*Risks of large-scale singular events such as ice sheet disintegration, methane release from clathrates, and onset of long-term droughts in areas such as southwest North America … are higher with increased*

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warming." "*Sustained warming greater than some threshold would lead to the near-complete loss of the Greenland ice sheet over a millennium or more, causing a global mean sea level rise of up to 7 m (high confidence)*;" "*The Atlantic Meridional Overturning Circulation (AMOC) will very likely weaken over the 21st century, with a best estimate of 34% loss (range 12 to 54%) under RCP8.5*."].

10 **Key climate risks assessed by the IPCC are only those linked to anthropogenic global warming.** IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pages [See Pages 13-19, from section SPM 2.3 Future risks and impacts caused by a changing climate, including page 14's Figure SPM.8 Representative key risks for each region, to understand the risks are linked only to global warming, and that no rapid climate change risks are detailed. See page 13, "*Rising rates and magnitudes of warming and other changes in the climate system, accompanied by ocean acidification, increase the risk of severe, pervasive and in some cases irreversible detrimental impacts. Some risks are particularly relevant for individual regions (Figure SPM.8), while others are global.* ***The overall risks of future climate change impacts can be reduced by limiting the rate and magnitude of climate change****, including ocean acidification*." "*A large fraction of species faces increased extinction risk due to climate change during and beyond the 21st century, especially as climate change interacts with other stressors (high confidence).*" See page 14, Extracts from: "*Figure SPM.8 Representative* ***key risks*** *for each region, including the potential for risk reduction through adaptation and mitigation, as well as limits to adaptation. Risk levels are presented for three time frames: present, near term (here, for 2030–2040) and long term (here, for 2080–2100). In the near term, projected levels of global mean temperature increase do not diverge substantially across different emission scenarios. For the long term,* ***risk levels are presented for two possible futures (2°C and 4°C global mean temperature increase above pre-industrial levels)****.*" See page 16, SPM 2.4 Climate change beyond 2100, irreversibility and abrupt changes; "*Warming will continue beyond 2100 under all RCP scenarios except RCP2.6. Surface temperatures will remain approximately constant at elevated levels for many centuries after a complete cessation of net anthropogenic CO2 emissions*."].

11 **IPCC tell us it is virtually certain that there will be more frequent hot and fewer cold temperature extremes.** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See page 20. Section E.1 Atmosphere Temperature. "*It is* ***virtually certain that there will be more frequent hot and fewer cold temperature extremes*** *over most land areas on daily and seasonal timescales as global mean temperatures increase. It is very likely that* ***heat waves will occur with a higher frequency and duration****. Occasional cold winter extremes will continue to occur."*].

12 **WG2 claim climate risks can be reduced by cutting emissions:** IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pages [See page 62, *"The overall risks of climate change impacts* ***can be reduced by limiting the rate and magnitude of climate change. Risks are reduced substantially under the assessed scenario with the lowest temperature projections*** *(RCP2.6 – low emissions) compared to the highest temperature projections (RCP8.5 – high emissions), particularly in the second half of the 21st century (very high confidence)."*].

13 **IPCC climate forecasts unrealistically assume no major volcanic eruptions or secular changes in solar irradiance (unrealistic)**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See page 20. Section E.1 Atmosphere Temperature

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"The global mean surface temperature change for the period 2016–2035 relative to 1986–2005 will likely be in the range of 0.3°C to 0.7°C (medium confidence). This assessment is based on multiple lines of evidence and ***assumes there will be no major volcanic eruptions or secular changes in total solar irradiance***."].

14 **Data sources:** The following global **/** global land and ocean surface temperature data files register **an average of a 0.47°C decline** in the global (land and ocean) surface temperature **since their respective Q1-2016 peaks (each index peak)**.
http://berkeleyearth.lbl.gov/auto/Global/Land_and_Ocean_complete.txt,
https://data.giss.nasa.gov/gistemp/tabledata_v3/GLB.Ts.txt,
https://data.giss.nasa.gov/gistemp/tabledata_v3/GLB.Ts+dSST.txt,
https://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/time_series/HadCRUT.4.6.0.0.annual_ns_avg.txt.

15 **The IPCC's highly inaccurate climate forecasts span 3-decades.** IPCC, Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See pages 61-63, Box TS.3, Climate Models and the Hiatus in Global Mean Surface Warming of the Past 15 Years. **(1)** "*However, an analysis of the full suite of CMIP5 historical simulations (augmented for the period 2006–2012 by RCP4.5 simulations) reveals that 111 out of 114 realizations show a GMST trend over 1998–2012 that is higher than the entire HadCRUT4 trend ensemble (Box TS.3, Figure 1a; CMIP5 ensemble mean trend is 0.21°C per decade)*." "*During the 15-year period beginning in 1998, the ensemble of HadCRUT4 GMST trends lies below almost all model-simulated trends (Box TS.3, Figure 1a), whereas during the 15-year period ending in 1998, it lies above 93 out of 114 modelled trends (Box TS.3, Figure 1b; HadCRUT4 ensemble mean trend 0.26°C per decade, CMIP5 ensemble mean trend 0.16°C per decade)*". **(2)** Scientifically weak explanation: "*This difference between simulated and observed trends could be caused by some combination of (a) internal climate variability, (b) missing or incorrect RF, and (c) model response error. These potential sources of the difference, which are not mutually exclusive, are assessed below, as is the cause of the observed GMST trend hiatus. {2.4.3, 9.3.2, 9.4.1; Box 9.2}.*" **(3)** Rather than refute its own radiative forcing theory and climate models the IPCC explains, "*The discrepancy between simulated and observed GMST trends during 1998–2012 could be explained in part by a tendency for some CMIP5 models to simulate stronger warming in response to increases in greenhouse-gas concentration than is consistent with observations."* This is followed by, "*As a consequence, it is argued in Chapter 11 that near-term model projections of* ***GMST increase should be scaled down by about 10%****. This downward scaling is, however, not sufficient to explain the model mean overestimate of GMST trend over the hiatus period. {10.3.1, 11.3.6}.*" **(4)** Despite this abject failure to accurately forecast the global mean surface temperature and credibly explain this inaccuracy, "*There is hence very high confidence that the CMIP5 models show long-term GMST trends consistent with observations, despite the disagreement over the most recent 15-year period.*" (i.e., climate hiatus.). **(5) NB:** This high inaccuracy of global temperature forecasts can simply be explained by the fact that the IPCC dismissed or omitted the role of the natural climate system in its weak explanation, its radiative forcing theory, and its forecasting models. See page 14. "*Figure SPM.5, Radiative forcing estimates in 2011 relative to 1750 and aggregated uncertainties for the main drivers of climate change.*" **NB:** According to these radiative forcing estimates, nearly all (98%) radiative forcing factors driving climate change are attributable to anthropogenic causes. This prior quotation contradicts the following statement, "*Although the forcing uncertainties are substantial, there are no apparent incorrect or missing global mean forcings in the CMIP5 models over the last 15 years that could explain the model–observations difference during the warming hiatus. {9.4.6}.*" **NB:** Yes there are missing climate forcings, commonly referred to as the natural climate system, which the IPCC has dismissed or omitted. The natural climate system (NCC) 'controls' seasonal-, annual-, decadal-, centennial-, millennial-scale, glacial cycle, and epochal temperature oscillations, just as it has done for billions of years. The NCC system includes solar activity (short term and secular changes to solar irradiance and magnetism), orbital modulation of solar outputs reaching earth, geomagnetism, cosmic rays and low clouds, volcanic aerosols, solar-earth orbital/rotational modulation of atmospheric and ocean

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circulations, ice cover-albedo, other cloud feedbacks (different latitudes and altitudes), and water vapor (natural), in addition to anthropogenic 'climate-modifiers' (land use, deforestation, greenhouse gases like water vapor from irrigation and fossil fuel combustion, and CO2), etc.].

16 **Climate hiatus data sources:** The following six global / global land and ocean surface temperature data files register **an average of a 0.04°C decline** (Standard deviation 0.04°C) in the **global temperature between 1998 and 2012**.
http://berkeleyearth.lbl.gov/auto/Global/Land_and_Ocean_complete.txt,
https://data.giss.nasa.gov/gistemp/tabledata_v3/GLB.Ts.txt,
https://data.giss.nasa.gov/gistemp/tabledata_v3/GLB.Ts+dSST.txt,
https://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/time_series/HadCRUT.4.6.0.0.annual_ns_avg.txt, https://www.ncdc.noaa.gov/cag/time-series/global/globe/land_ocean/p12/12/1880-2017.csv,
http://www-users.york.ac.uk/~kdc3/papers/coverage2013/had4_krig_v2_0_0.txt. (Data downloaded 30/07/2019).

17 **Changes in atmospheric CO2 concentration between 1998 and 2012, and 2016 and 2018.** NOAA ESRL monthly carbon dioxide data (CO2 expressed as a mole fraction in dry air, micromol/mol, abbreviated as ppm, since 1958) was obtained from www.esrl.noaa.gov/gmd/ccgg/trends/ using the following data file ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_mm_mlo.txt (Downloaded 03/08/2019). [Data: The atmospheric CO2 concentration (ppm) in 01/1998 was 365.3 ppm and in 12/2012 was 394.3 ppm, yielding an **8.0% increase**. The Atmospheric CO2 concentration (ppm) in 01/2016 was 402.6 and 06/2019 was 413.9 ppm, yielding a **2.8% increase**.].

18 Ole Humlum et al., "The phase relation between atmospheric carbon dioxide and global temperature." Global and Planetary Change. Volume 100, January 2013, 51-69.

19 Manfred Mudelsee, "The phase relations among atmospheric CO2 content, temperature and global ice volume over the past 420 ka." Quaternary Science Reviews 20 (2001) 583-58.

20 Eric Monnin et al., "Atmospheric CO2 Concentrations over the Last Glacial Termination." By Science 05 Jan 2001: 112-114.

21 N. Caillon et al., 2003, "Timing of atmospheric CO2 and Antarctic temperature changes across Termination III." Science 299: 1728-1731.

22 H. Fischer et al., 1999, "Ice core records of atmospheric CO2 around the last three glacial terminations." Science, 283, 1712-1714.

23 Thomas S. Kuhn, The Structure of Scientific Revolutions. Second Edition, Enlarged. International Encyclopedia of Unified Science. © 1962, 1970 by The University of Chicago. All rights reserved. Published 1962. Second Edition, enlarged, 1970.

24 **Data alterations between the current** and older **versions of global climate indices** (UK, USA) accentuate recent global warming. These indices are commonly used by the IPCC**.** Data: The UK MetOffice, HadCRUT4 versus 3 versions: Anomaly differences were calculated by subtracting the HadCRUT3 global annual anomalies from the HadCRUT.4.6.0.0 (current version) global annual anomalies. https://www.metoffice.gov.uk/hadobs/hadcrut4/data/versions/previous_versions.html, https://crudata.uea.ac.uk/cru/data/crutem3/HadCRUT3-gl.dat. NASA GISTemp 2017 versus 2000 versions: Anomaly differences were calculated by subtracting the 2000 NASA GISTemp from the 2017 NASA GISTemp anomalies. Data: https://go.nasa.gov/2KFY3IZ using data files; (1) 2000_12_v2_GLB.Ts.csv, (2) 2017_07_v3_GLB.Ts.csv. [Conclusions: This data analysis, complemented by the following two endnote citations, supports the conclusion that global climate indices provided by US/UK government agencies are unfit for policy sensitive decision making. The following two endnotes cite research demonstrating that significant alterations have taken place between old and new versions of HadCRUT GMST, NASA GISTemp, and NOAA GAST global temperature indices. **These alterations included the significant changing** of stations, time of observation, significant errors and missing data, the impact of population growth and urban heat island effect, the changing of land and sea observation ratios, and the introduction of new measuring technology. In 1990, when the IPCC's Article 1 and 2 climate science dictatorship came to power, there was a major station dropout (75%), leaving an urban bias of temperature stations (heat island effect) with 49% of the stations being located at airports. This is tantamount to data fiddling.

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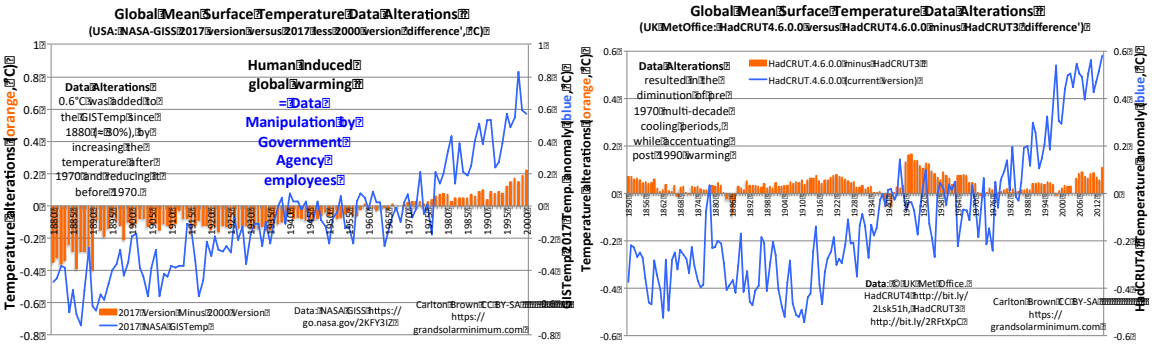
Global Mean Surface Temperature Data Alterations
(USA: NASA-GISS 2017 version versus 2017 less 2000 version 'difference', °C)
Temperature alterations (orange, °C)
GISTemp 2017 Temp. anomaly (blue, °C)
Data Alterations
0.6°C was added to the GISTemp since 1880 (=30%), by increasing the temperature after 1970 and reducing it before 1970.
Human induced global warming
=
Data Manipulation by Government Agency employees
2017 Version Minus 2000 Version
2017 NASA GISTemp
Data: NASA GISS https://go.nasa.gov/2KFY3IZ
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Global Mean Surface Temperature Data Alterations
(UK MetOffice: HadCRUT4.6.0.0 versus HadCRUT4.6.0.0 minus HadCRUT3 'difference')
HadCRUT4 Temperature anomaly (blue, °C)
Data Alterations resulted in the diminution of pre-1970 multi-decade cooling periods, while accentuating post-1990 warming
HadCRUT.4.6.0.0 minus HadCRUT3
HadCRUT.4.6.0.0 (current version)
Data: © UK MetOffice HadCRUT4 http://bit.ly/2Lsk51h, HadCRUT3 http://bit.ly/2RFtXpC
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25 **The fabrication of global climate index data by US government agencies accounts for most of the recent global warming.** Craig Idso, 2017. On the Validity of NOAA, NASA and Hadley CRU Global Average Surface Temperature Data & The Validity of EPA's CO2 Endangerment Finding. https://www.heartland.org/publications-resources/publications/on-the-validity-of-noaa-nasa-and-hadley-cru-global-average-surface-temperature-data--the-validity-of-epas-co2-endangerment-finding [Conclusion: "*This paper shows the* ***global temperature data used to estimate global average temperatures*** *and thus* ***make climate policy is flawed*** *with* ***politicized adjustments accounting for almost all the warming*** *since the middle of the 20th century*." Craig Idso is a member of the Nongovernmental International Panel on Climate Change (NIPCC), an international panel of expert climate scientists established to provide an independent evaluation of the scientific evidence (or lack of) relating to carbon dioxide-induced global warming. "*NIPCC scientists* ***concluded the IPCC was biased with respect to making future projections of climate change****, discerning a significant human-induced influence on current and past climatic trends, and evaluating the impacts of potential carbon dioxide-induced environmental changes on Earth's biosphere.*"].

26 **An audit of HadCRUT4 global climate index raises issues regarding errors and uncertainties**. McLean, John D. (2017). An audit of uncertainties in the HadCRUT4 temperature anomaly dataset plus the investigation of three other contemporary climate issues. PhD thesis, James Cook University. https://doi.org/10.4225/28/5afb68f31fb3f. https://researchonline.jcu.edu.au/52041/. [**Notable abstract quotes highlighting the errors and uncertainties**: "*Authors of the IPCC's Fifth Climate Assessment Report (2013) admitted during the review process for that report that no audit of the HadCRUT4 dataset or any associated dataset had been undertaken*." "*Data coverage was found to vary between 12% and 91% of the Earth's surface, … . Also revealed was that when coverage was low it was found to be concentrated on particular regions, meaning for example that less than 13% of a hemisphere might account for more than 60% of the data coverage for that hemisphere in a given month.*" "*Sample size was another problem. A single observation station in the entire Southern hemisphere reported data in the first three years of the HadCRUT4 record and only nine were reporting by 1859. … . More than 30% of the grid cells derived from sea surface temperature do so from 1850 to about 1950 on the basis of from one to five measurements in the entire month.*" "*Outliers were also discovered in the data, even in the 30-year period from 1961 to 1990 over which long-term average temperatures are … . Their presence in these periods firstly widens the range of acceptable values (i.e. includes the inclusion of other outliers) and secondly distorts the crucial long-term average temperatures*." "*Numerous other inconsistencies and uncertainties were identified, including differences between dataset values that should be identical, unexplained differences between land and sea temperatures, inconsistent sources of coastal temperature data, questionable "bulk adjustment" to sea surface temperature data, poor data quality control and possible errors in the processing of land and sea temperature data prior to their submission for inclusion in the dataset*." "*Over 25 findings are presented in the summary to part 1of the thesis,* ***the most serious being that HadCRUT4 global averages prior to 1950 are of limited value*** *because for almost all of the period from 1850 to 1950 the coverage of the Earth's surface was less than 50%.*"

27 Global mean surface temperature data, commonly referred to as HadCRUT4. https://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/time_series/HadCRUT.4.6.0.0.annual_ns_avg.txt. [last downloaded 06/11/2019].

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28 IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 [See page 288 "*The 1997–1998 event was the largest on record in terms of SST anomalies and the global mean temperature in 1998 was the highest on record (at least until 2005)*."].

29 **Data:** (1) B.M. Vinther et al., 2009. "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, September 17, 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018. (2) HadCRUT4 near surface temperature data set for the Northern Hemisphere. http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/download.html. Downloaded July 25, 2018. Personal Research: Between the Holocene Climate Optimum (HCO) 5980 BCE and 1700 CE the Greenland temperature anomaly (derived from the ice core) declined 4.86°C. Between 1700-1940 the temperature rose 2.87°C. From this data, it was calculated that the temperature in 2016 was 1.91°C lower than at the Holocene Climate Optimum. 1700-1960 rise = 2.32°C rise plus a "graft-on" of a 1960-2016 temperature anomaly rise of 0.63°C. To determine the 1960-2016 temperature anomaly rise the HADCRUT4 Northern Hemisphere near surface temperature data was utilized to create a 20-year moving average, to graft on to the 1700-1960 (+0.63°C). HCO-2016 approximation = -4.86°C + 2.32°C +0.63°C = -1.91°C.

30 Nicolaj K. Larsen et al., "The response of the southern Greenland ice sheet to the Holocene thermal maximum." Geology ; 43 (4): 291–294. doi: https://doi.org/10.1130/G36476.1.

31 D.S. Kaufman et al., "Holocene thermal maximum in the western Arctic (0–1800W)." Quaternary Science Reviews 23 (2004) 529–560.

32 J.P. Briner et al., "Holocene climate change in Arctic Canada and Greenland." Quaternary Science Reviews (2016), http://dx.doi.org/10.1016/j.quascirev.2016.02.010.

33 **Data:** Northern Hemisphere and global temperature anomalies (22-year moving averages) highlight this current warm phase, that potentially ended in early 2016, started long before the IPCC's 1880 climate reference period i.e., in the late 17th and early 18th centuries, and long before theoretical anthropogenic global warming that relies on fabricated climate indices. (1) Vinther et al., https://www.ncdc.noaa.gov/paleo-search/study/11148. (2) https://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/time_series/HadCRUT.4.6.0.0.annual_ns_avg.txt. (3) T. Kobashi et al., https://www.ncdc.noaa.gov/paleo/study/15535. (4) P.W. LeClercq et al., Global and N-Hemi, https://www.ncdc.noaa.gov/paleo/study/13544. (5) S. Huang, https://www.ncdc.noaa.gov/paleo/study/6325. (6) G.C. Hegerl et al., https://www.ncdc.noaa.gov/paleo/study/14749. (7) C.L. Smith et al., https://www.ncdc.noaa.gov/paleo/study/6259. (8) A. Moberg et al., https://www.ncdc.noaa.gov/paleo/study/6267. (9) T. Kobashi et al., https://www.ncdc.noaa.gov/paleo-search/study/22057.

34 **The Greenland ice core data highlights 8 millennia of devolving climate oscillations from the Holocene Climate Optimum to 1700CE** (Temperatures declined 4.86°**C**). Data: (1) B.M. Vinther et al., 2009, "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, 17 September 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018. (2) HadCRUT4 near surface temperature data set for the Northern Hemisphere. http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/download.html. Downloaded 25 July 2018. Analysis: Between the Holocene Climate Optimum 5980 BCE (+3.55°C anomaly) and the deepest temperature trough in 1700 CE (-1.31°C anomaly) **the temperature declined 4.86**°C. Between **1700 and 1940 the temperature then rose** 2.87°C. This means that the 1940 temperature was still 2°C lower than at the Holocene Climate Optimum. This decline to 1700 CE and then increase in temperature (1700-1940) occurred in a devolving oscillatory manner. These oscillations comprised 39 trough-to-peak warming and then cooling phases exceeding +0.99°C from their deepest trough to their tallest peak, between 5980 BCE (i.e., the Greenland/Arctic glacial cycle peak temperature) and 1940 CE. These 39 warming phases were extracted for group analysis (range,

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+0.99°C to +2.87°C, average 77.4 years trough-to-peak, n=39). A goodness-of-fit test of all 39 trough-to-peak temperature rises showed that the data did not follow a normal distribution. This indicated the possibility that more than one warming process may be involved with the bigger climate oscillation outliers (i.e., for example an extreme grand solar maximum phase, or a large climate forcing volcanic eruption). Results: Prior to stratifying the data an Iglewicz and Hoaglin's robust test (two-sided test) for multiple outliers was performed using a modified Z score of ≥1.5 and ≥5 as the outlier criteria. The modified Z score of ≥1.5 highlighted significant outliers above +1.77°C. A higher modified Z score of ≥5 yielded **the most extreme outlier trough-to-peak** warming phase **between 1700 and 1940** (**+2.87**°C)**.** Given the outliers that were revealed, the data was then stratified into two groups (Group 1: ≥ 1.77°C and Group 2: 0.99°C - 1.76°C). This stratification yielded 2 normally distributed groups (Group-1, N=5, Group-2 N=34), that were, statistically, significantly different from one another (unpaired Welch T-Test, 2-tailed P-value = 0.007). Group 1's smallest temperature rise was 0.21°C greater than Group 2's largest temperature rise, highlighting the temperature gap between the two groups. On the basis of the above, the peak-to-trough temperature rise from 1700 to 1940 (+2.87°C) was confirmed as the most significant outlier. This process was repeated for the grafted peak from 1840-2016 (+2.81°C) as detailed in Revolution's Figures 4.1-4.2. The modified Group-1 that swapped the +2.87°C with the +2.81°C, was also significantly different from Group-2 (unpaired Welch T-Test, two-sided P-value = 0.0061). Conclusion: Group-1 (N=5) composed of trough-to-peak outliers ≥ 1.77°C were significantly larger global warming phases than Group-2 (N=34), and the +2.87°C or +2.81°C (i.e., Devil's advocate peak from 1840 plus a 20-year moving average graft to 2016's peak defined by the HadCRUT4 GMST/Northern hemisphere data) were the largest outliers.

35 **The IPCC acknowledge that solar and volcanic activity contributed substantially to the LIA's climate change, yet ignored this science in their forecasts and key-risk assessment.** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See page 1151, "*The combined records indicate that a net decline of global glacier volume began in the 19th century, before significant anthropogenic RF had started, and was probably the result of warming associated with the termination of the Little Ice Age (Crowley, 2000; Gregory et al., 2006, 2013b).*"]

36 Data: B.M. Vinther et al., 2009, "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, 17 September 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018. Personal Research: Between the Holocene Climate Optimum in 5980 BCE (temperature anomaly +3.55°C) and the deepest temperature trough in 1700 CE (temperature anomaly -1.31°C) the temperature declined by 4.86°C (4.86°C = +3.55°C less -1.31°C). From this deep temperature trough in 1700 up to 1940, the temperature rose 2.87°C.].

37 **Data:** (1) B.M. Vinther et al., 2009, "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, 17 September 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018. (2) HadCRUT4 near surface temperature data set for the Northern Hemisphere. http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/download.html. Downloaded 25 July 2018. **Personal Research**: All 39 climate trough-to-peak temperature rises exceeding +0.99°C, between 5980 BCE and 1940 CE were extracted from the temperature data, derived from the Greenland ice core, for group analysis (range, +0.99°C to +2.87°C, average 77.4 years trough-to-peak, n=39). These trough-to-peak temperature increases selected trough-to-peaks to start from the deepest time point in the maximum trough preceding the tallest peak. A goodness-of-fit test of all 39 trough-to-peak temperature rises showed that the data did not follow a normal distribution. This indicates the possibility that more than one global warming process may be involved with the bigger climate oscillation outliers (i.e., an extreme grand solar maxima). **Results**: Prior to stratifying the data an Iglewicz and Hoaglin's robust test (two-sided test) for multiple outliers was performed using a modified Z score of ≥1.5 and ≥5 as the outlier criteria. The modified Z score of ≥1.5 highlighted

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significant outliers above +1.77°C. A higher modified Z score of ≥5 yielded the most extreme outlier the +2.87°C trough-to-peak between 1700 and 1940. Given the outliers that were revealed, the data was stratified into two groups (0.99°C - 1.77°C or ≥ 1.77°C). This stratification yielded 2 normally distributed groups (Group-1, N=5, Group-2 N=34), that were, statistically, significantly different from one another (unpaired Welch T-Test, 2-tailed P-value = 0.007). Group 1's smallest temperature rise was 0.21°C greater than Group 2's largest temperature rise, highlighting the gap between the two groups. On the basis of the above, the peak-to-trough temperature rise from 1700 to 1940 (+2.87°C) was confirmed as the most significant outlier. This process was repeated for the grafted peak from 1840-2016 (+2.81°C) as detailed in Figure 4.1. Group-1 swapped the +2.87°C with the +2.81°C, which was also statistically, significantly different from Group-2 (unpaired Welch T-Test, two-sided P-value = 0.0061). **Conclusion**: Group-1 (N=5) composed of trough-to-peak outliers ≥ 1.77°C represented significantly larger global warming periods than Group-2 (N=34), and the +2.87°C or +2.81°C were the largest outliers.

38 Robert K. Booth et al., "A severe centennial-scale drought in midcontinental North America 4200 years ago and apparent global linkages." The Holocene. Volume 15, Issue 3, 321 – 328. 2005. https://doi.org/10.1191/0959683605hl825ft.

39 J. Stanley et al., 2003, "Nile flow failure at the end of the Old Kingdom, Egypt: Strontium isotopic and petrologic evidence." Geoarchaeology, 18: 395-402. doi:10.1002/gea.10065.

40 Ann Gibbons, "How the Akkadian Empire Was Hung Out to Dry". Science 20 Aug 1993: Volume 261, Issue 5124, DOI: 10.1126/science.261.5124.985.

41 Jianjun Wang, "The abrupt climate change near 4,400 year BP on the cultural transition in Yuchisi, China and its global linkage." Scientific Reports | 6:27723 | DOI: 10.1038/srep27723. https://www.nature.com/articles/srep27723.pdf.

42 **WG1 (AR4) deferred the ice age 30,000 years without subjecting that erroneous assumption to peer review** (falsifiable; see endnotes 83-95). IPCC, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pages [See page 56, Box TS.6. "*The Milankovitch, or 'orbital' theory of the ice ages is now well developed. Ice ages are generally triggered by minima in high-latitude NH summer insolation, enabling winter snowfall to persist through the year and therefore accumulate to build NH glacial ice sheets."* Followed by*, "Available evidence indicates that the current warming will not be mitigated by a natural cooling trend towards glacial conditions. Understanding of the Earth's response to orbital forcing indicates that the Earth would not naturally enter another ice age for at least 30,000 years. {6.4, FAQ 6.1}.*" See page 85 section TS.6.2.4 Paleoclimate under "***Robust Findings***" "***It is very unlikely that the Earth would naturally enter another ice age for at least 30,000 years***. *{6.4}*").].

43 **WG1 (AR5) dismissed the ice age by 50,000 years without subjecting that erroneous assumption to peer review** (falsifiable; see endnotes 83-95). IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See Page 70, "*It is virtually certain that orbital forcing will be unable to trigger widespread glaciation during the next 1000 years. Paleoclimate records indicate that, for orbital configurations close to the present one, glacial inceptions only occurred for atmospheric CO2 concentrations significantly lower than pre-industrial levels. Climate models simulate no glacial inception during the next 50,000 years if CO2 concentrations remain above 300 ppm. {5.8.3, Box 6.2}."* NB: Given the IPCC's 3-decade legacy of generating highly inaccurate climate forecasts serious caution is merited with this opinion.].

44 **The last ice age ended about 10,000 years ago (falsifiable, see endnote 55)**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See page 124,

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Table 1.1. "***Since the end of the last ice age, about 10,000 years ago****, global surface temperatures have probably fluctuated by little more than 1°C.*"].

45 **Clarification of glacial cycle nomenclature and points of glacial cycle reference.** It is important to clarify glacial cycle nomenclature linked to the dynamic interplay between the temperature, ice volume, and sea level changes over glacial cycle time scales. For **consistency** across all glacial cycles, ice ages end after the glacial maximum (i.e., for analytical purposes this corresponds to a glacial cycle's lowest temperature data point, and its associated lowest sea level and maximum ice volume). Thereafter, the interglacial temperature, and sea level rises, and ice volume reduces, **in an oscillatory manner**. Ice age's commence after the climate optimum (i.e., for analytical purposes this corresponds to a glacial cycle's peak temperature data point at the end of the sustained interglacial rise, and its associated highest sea level and lowest ice volume). Thereafter, the ice age inception temperature declines, the ice volume slowly increases, and the sea level declines, in an oscillatory manner. These temperature, ice volume, and sea level changes and glacial cycle reference points are evidenced by analyzing the following three million year global climate data reconstruction: **R. Bintanja and R.S.W. van de Wal**, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158.

46 R.B. Alley, 2004, "GISP2 Ice Core Temperature and Accumulation Data." National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. https://www.ncdc.noaa.gov/paleo/study/2475. Downloaded 05/05/2018.

47 Sigfus J. Johnsen et al., 1997, "The d18O record along the Greenland Ice Core Project deep ice core and the problem of possible Eemian climatic instability." Journal of Geophysical Research: Oceans, 102(C12), 26397-26410. doi: 10.1029/97JC00167. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. GRIP Ice Core 248KYr Oxygen Isotope Data. https://www.ncdc.noaa.gov/paleo-search/study/17839.

48 R.V. Uemura et al., 2012, "Ranges of moisture-source temperature estimated from Antarctic ice cores stable isotope records over glacial-interglacial cycles." Climate of the Past, 8, 1109-1125. doi: 10.5194/cp-8-1109-2012. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Dome Fuji 360KYr Stable Isotope Data and Temperature Reconstruction. https://www.ncdc.noaa.gov/paleo-search/study/13121. Downloaded 05/05/2018.

49 J. V. Jouzel et al., 2007, "Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years." Science, Volume 317, No. 5839, 793-797, 10 August 2007. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. EPICA Dome C - 800KYr Deuterium Data and Temperature Estimates. https://www.ncdc.noaa.gov/paleo/study/6080. Download data: Downloaded 08/02/2016.

50 R. Bintanja and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015.

51 B.M. Vinther et al., 2009, "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, 17 September 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018.

52 Sigfus J. Johnsen et al., 1997, "The d18O record along the Greenland Ice Core Project deep ice core and the problem of possible Eemian climatic instability." Journal of Geophysical Research: Oceans, 102(C12), 26397-26410. doi: 10.1029/97JC00167. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. GRIP Ice Core 248KYr Oxygen Isotope Data. https://www.ncdc.noaa.gov/paleo-search/study/17839.

53 R. Bintanja and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015.

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54 IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See page 124, Table 1.1. "*Since the end of the last ice age, about 10,000 years ago, global surface temperatures have probably fluctuated by little more than 1°C.*"].

55 **The last ice age did not end "about 10,000 years ago" (falsifiable)**. Data: R. Bintanja and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015. Analysis: Using the above-cited file, the temperature and sea level data were extracted since the Last glacial maximum (i.e., minimum glacial cycle temperature 19,600 years ago and ≈maximum ice mass and ≈minimum sea level) to the Holocene Climate Optimum (i.e., maximum glacial cycle temperature 2,100 years ago and ≈minimum ice mass and ≈maximum sea level), and the corresponding data for 10,000 years ago. Results: **(A) By 10,000 years ago the sea level had already risen about 80% and the temperature 91% of their total Holocene interglacial rise** (from glacial maximum to climate optimum). This confirms the last ice age did not end "*about 10,000 years ago*." **(B)** This global climate data also highlights that the northern hemisphere glaciers (i.e., Eurasian and North American ice volume) contributed 87% of the total Holocene interglacial sea level rise making the Arctic key to understanding climate change.].

Time (Kyr before Y2K)	Temp (Deg.C)	Global Sea Level (m)		Sea Level Equivalents (SLE, meters)	Difference (SLE meters) LGM to HCO	Percentage contribution to total Holocene Interglacial sea level rise
Y2K 0 Kyr			NH Ice Vol at 19,600 YBP	107.3		
Holocene Climate Optimum 2.1 Kyr	0.56	2.87	NH Ice Vol at 2,100 YBP	2.6	104.7	87%
10,000 years ago	-0.9	26.8	SH & Other at 19,600 YBP	16.1		
Glacial Maximum 19.6 Kyr	-15.9	123.4	SH & Other at 2,100 YBP	0.3	15.8	13%
	Deg.C	**Meters**	Sea level at 19,600 YBP	123.4		
Total Holocene Interglacial Increase	16.5	120.5	Sea level at 2,100 YBP	2.9	120.5	
Increase from Glacial Maximum to 10.0Kyr	15.0	96.6				
% of Holocene Interglacial Increase by 10.0 Kyr	91.2%	80.2%				

56 **Data:** B.M. Vinther et al., 2009, "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, 17 September 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018. **Analysis**: Between the Holocene Climate Optimum 5980 BCE (+3.55°C anomaly) and the deepest temperature trough in 1700 CE (-1.31°C anomaly) the temperature declined 4.86°C].

57 R.B. Alley, 2004, "GISP2 Ice Core Temperature and Accumulation Data." National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. https://www.ncdc.noaa.gov/paleo/study/2475. Downloaded 5/5/2018. [Last Glacial Maximum's deepest temperature trough was 24,098 years ago (-53°C) and the Holocene Climate Optimum was 7,800 years ago (-28.86°C). The difference between these time points is 16,297 years and 24.56°C.]

58 **Data:** J. V. Jouzel et al., 2007, "Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years." Science, Volume 317, No. 5839, 793-797, 10 August 2007. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. EPICA Dome C - 800KYr Deuterium Data and Temperature Estimates. https://www.ncdc.noaa.gov/paleo/study/6080. Downloaded data 08/02/2016. **Analysis**: Between the highest temperature recorded at the Holocene Climate Optimum (HCO) 8570 BCE (a +2.12°C anomaly) and the deepest temperature trough in 1738 CE (a -2.44°C anomaly) the temperature declined 4.56°C. Between the Last Glacial Maximum, or the deepest temperature trough at 17003 BCE (a -10.43°C anomaly) and the HCO the ice core temperature increased by 12.55°C. Therefore, between the 8570 BCE and 1738 CE the Antarctic temperature decline of 4.56°C represented about one-third of its Holocene interglacial temperature rise (in absolute magnitude)].

59 H. Wanner et al., "Structure and origin of Holocene cold events." Quaternary Science Reviews (2011), doi:10.1016/j.quascirev.2011.07.010. [Comment: See Figure 5a, page 9, depicting the steady decline in Northern Hemisphere summer solar insolation at north 15 and 65 degree latitudes, and

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indicating that **insolation has declined by about 40 W/m2.** This is based on the landmark research by Berger, 1978 (André Berger, Long-Term Variations of Daily Insolation and Quaternary Climatic Changes. 1978. Journal of the Atmospheric Sciences 35(12):2362-2367. DOI: 10.1175/1520-0469(1978)035<2362:LTVODI>2.0.CO;2).].

60 D.S. Kaufman et al., "Holocene thermal maximum in the western Arctic (0–180°W)." Quaternary Science Reviews, Volume 23, Issues 5–6, 2004, 529-560. https://doi.org/10.1016/j.quascirev.2003.09.007. [Comment: See the abstract. We are told that the **precession-driven summer insolation anomaly peaked 12,000-10,000 years ago.** See also Figure 9a which depicts the 65°N insolation anomaly at different times of the year, indicating a ≈**50 Wm-2 decline in summer solstice insolation from its peak** 12,000-10,000 years ago.].

61 I. Borzenkova et al., 2015. Climate Change During the Holocene (Past 12,000 Years). In: The BACC II Author Team (eds) Second Assessment of Climate Change for the Baltic Sea Basin. Regional Climate Studies. Springer. https://link.springer.com/content/pdf/10.1007%2F978-3-319-16006-1.pdf

62 US Environmental Protection Agency. Climate Change Indicators: Climate Forcing. https://www.epa.gov/climate-indicators/climate-change-indicators-climate-forcing#ref1.

63 G.H. Miller et al., 2012, "Abrupt onset of the Little Ice Age triggered by volcanism and sustained by sea-ice/ocean feedbacks." Geophysical Research Letters, 39, L02708, doi:10.1029/2011GL050168. [Comment: We are told in the opening sentence that the **Northern Hemisphere summer temperatures track a precession-driven decline in summer insolation for 8,000 years, and that the summer temperature changes are the greatest in the Arctic.** This article cites CAPE Project Members, 2001; Kaufman et al., 2004; Vinther et al., 2009.].

64 Y. Zhong et al., "Centennial-scale climate change from decadally-paced explosive volcanism: a coupled sea ice-ocean mechanism." Climate Dynamics (2011) 37: 2373. https://doi.org/10.1007/s00382-010-0967-z. [Comment: The abstract tells us the **Northern Hemisphere Holocene summer cooling was driven largely by the decline in precession-modulated summer insolation.** This summer decline in insolation from 8,000 years ago in the Northern Hemisphere **led to glacier ice expansion,** especially from 5,000 years ago.].

65 Nicolaj K. Larsen et al., "The response of the southern Greenland ice sheet to the Holocene thermal maximum." Geology ; 43 (4): 291–294. doi: https://doi.org/10.1130/G36476.1.

66 J.P. Briner et al., "Holocene climate change in Arctic Canada and Greenland." Quaternary Science Reviews (2016), http://dx.doi.org/10.1016/j.quascirev.2016.02.010.

67 Leonid Polyak et al., "History of sea ice in the Arctic." Quaternary Science Reviews 29 (2010) 1757–1778, https://doi.org/10.1016/j.quascirev.2010.02.010.

68 Ó. Ingólfsson et al., 1998, "Antarctic glacial history since the Last Glacial Maximum: An overview of the record on land. "Antarctic Science, 10(3), 326-344. doi:10.1017/S095410209800039X.

69 Leonid Polyak et al. "History of sea ice in the Arctic." Quaternary Science Reviews 29 (2010) 1757–1778, https://doi.org/10.1016/j.quascirev.2010.02.010

70 N.L. Balascio et al. "Glacier response to North Atlantic climate variability during the Holocene." Climate of the Past, 11, 1587-1598, https://doi.org/10.5194/cp-11-1587-2015, 2015.

71 The RAISED Consortium1, Michael J. Bentley et al., "A community-based geological reconstruction of Antarctic Ice Sheet deglaciation since the Last Glacial Maximum." Quaternary Science Reviews. Volume 100, 15 September 2014, 1-9.

72 M. Frezzotti1 et al. "A synthesis of the Antarctic surface mass balance during the last 800 years." The Cryosphere, 7, 303–319, 2013. www.the-cryosphere.net/7/303/2013/doi:10.5194/tc-7-303-2013 © Author(s) 2013. CC Attribution 3.0 License.

73 Leonid Polyak et al., "History of sea ice in the Arctic." Quaternary Science Reviews 29 (2010) 1757–1778, https://doi.org/10.1016/j.quascirev.2010.02.010.

74 N. L. Balascio et al., "Glacier response to North Atlantic climate variability during the Holocene." Climate of the Past, 11, 1587-1598, https://doi.org/10.5194/cp-11-1587-2015, 2015.

75 O.N. Solomina et al., 2016, "Glacier fluctuations during the past 2000 years." Quaternary Science Reviews, 149, 61-90. DOI: 10.1016/j.quascirev.2016.04.008. [See Figure 5, page 276. This figure collates a stacked time series of the number of glacier advances and recessions in each reg ion into a global total.].

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76 Michael E Mann. “Little Ice Age.” Volume 1, The Earth system: physical and chemical dimensions of global environmental change, 504–509. In Encyclopedia of Global Environmental Change (ISBN 0-471-97796-9).

77 Michael E Mann, “Little Ice Age.” Volume 1, The Earth system: physical and chemical dimensions of global environmental change, 504–509. In Encyclopedia of Global Environmental Change (ISBN 0-471-97796-9).

78 Leonid Polyak et al., “History of sea ice in the Arctic.” Quaternary Science Reviews 29 (2010) 1757–1778, https://doi.org/10.1016/j.quascirev.2010.02.010.

79 Christophe Kinnard et al., “A changing Arctic seasonal ice zone: Observations from 1870–2003 and possible oceanographic consequences.” Geophysical Research Letters, Volume 35, L02507, doi:10.1029/2007GL032507, 2008.

80 O.N. Solomina et al., (2016). “Glacier fluctuations during the past 2000 years.” Quaternary Science Reviews, 149, 61-90. DOI: 10.1016/j.quascirev.2016.04.008. [See Figure 5, page 276.
This figure collates a stacked time series of the number of glacier advances and recessions in each reg ion into a global total.].

81 The RAISED Consortium1, Michael J. Bentley et al. “A community-based geological reconstruction of Antarctic Ice Sheet deglaciation since the Last Glacial Maximum.” Quaternary Science Reviews. Volume 100, 15 September 2014, 1-9.

82 **The massive glacier ice-melt after the Little Ice Age was initiated before significant human greenhouse gas emissions** (i.e., something else caused/controlled the melt). IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See page 1151, “*The combined records indicate that a net decline of global glacier volume began in the 19th century, **before significant anthropogenic RF had started**, and was probably the result of warming associated with the termination of the Little Ice Age (Crowley, 2000; Gregory et al., 2006, 2013b).*” NB: implicit in this statement is the fact that non-anthropogenic global warming caused the termination of the Little Ice Age i.e., solar irradiance and magnetized solar wind and their multi-faceted impact on the climate system.]

83 **WG1 (AR4) deferred the ice age 30,000 years without subjecting that perilously dangerous and erroneous assumption to peer review.** IPCC, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pages [See page 56, Box TS.6. “*The Milankovitch, or ‘orbital’ theory of the ice ages is now well developed. Ice ages are generally triggered by minima in high-latitude NH summer insolation, enabling winter snowfall to persist through the year and therefore accumulate to build NH glacial ice sheets.”* Followed by*, “Available evidence indicates that the current warming will not be mitigated by a natural cooling trend towards glacial conditions. Understanding of the Earth’s response to orbital forcing indicates that the Earth would not naturally enter another ice age for at least 30,000 years. {6.4, FAQ 6.1}.*” See page 85 section TS.6.2.4 Paleoclimate under “***Robust Findings***” “***It is very unlikely that the Earth would naturally enter another ice age for at least 30,000 years.*** *{6.4}*”).].

84 **WG1 (AR5) dismissed the ice age by 50,000 years without subjecting that perilously dangerous and erroneous assumption to peer review.** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See Page 70, “***It is virtually certain that orbital forcing will be unable to trigger widespread glaciation during the next 1000 years.*** *Paleoclimate records indicate that, for orbital configurations close to the present one, glacial inceptions only occurred for atmospheric CO2 concentrations significantly lower than pre-industrial levels. Climate models simulate no glacial inception during the next 50,000 years if CO2 concentrations remain above 300 ppm. {5.8.3, Box 6.2}.*”].

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85 **Falsifying the IPCC's 30,000 ice age delay based on a statistical analysis of the climate data from the last two million years** (which the IPCC omitted to do). **(1)**. Inter-climate optimum intervals: Data: Bintanja, R. and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015. Analysis: The following table data summary was created detailing 2,026,800 years of global climate optima timings and intervals (from peak-to-peak; Kiloyears). Without any change to the 2.1Kyr climate optimum recorded in the data 2,100 years ago (i.e., without a 30,000-year extension to the Holocene interglacial period), the current largest climate optimum interval of 122.7 kiloyears (i.e., 2.1-124.8Kyr peak) is not a statistically significant outlier (P>0.05) compared with the group (N=33). However, when this interglacial period is extended 30,000 years the revised climate optima interval (154.8 kiloyears) becomes a statistically significant outlier (P<0.05). For the revised dataset (with the 30,000-year extension): the Mean = 62.3, standard deviation = 30.2, N = 33. Outlier detected? Yes. Significance level: 0.05 (two-sided). Critical value of Z: 2.95. A goodness of fit was pre-assessed for the original unmodified data (i.e., no 30Kyr delay) using the d'Agostino-Pearson test: P = 0.095. On this basis the Grubb's outlier test was selected because the original data was normally distributed. When the 122.7Kyr climate optimum interval was substituted with the 154.8Kyr data point the d'Agostino-Pearson test: P = 0.011. This 30,000-year modification changed the data-population distribution to a non-normal distribution. This change in data distribution adds further support that the 30,000-year delay can not be statistically justified.

Climate Optimum Peak (Kyr)	**2.1**	**124.8**	**241.3**	**329.4**	**403.5**	**492.2**	**612.4**	**697.9**	**783.0**	**859.2**	**957.1**	
Climate Optima Interval (Kyr)	122.7	116.5	88.1	74.1	88.7	120.2	85.5	85.1	76.2	97.9	66.5	
Climate Optimum Peak (Kyr)	**1023.6**	**1073.6**	**1167.9**	**1241.3**	**1281.7**	**1317.2**	**1355.3**	**1399.0**	**1438.9**	**1477.6**	**1521.7**	
Climate Optima Interval (Kyr)	50.0	94.3	73.4	40.4	35.5	38.1	43.7	39.9	38.7	44.1	43.9	
Climate Optimum Peak (Kyr)	**1565.6**	**1604.4**	**1632.0**	**1685.1**	**1738.0**	**1774.3**	**1811.1**	**1856.9**	**1889.0**	**1934.9**	**1981.8**	**2026.8**
Climate Optima Interval (Kyr)	38.8	27.6	53.1	52.9	36.3	36.8	45.8	32.1	45.9	46.9	45.0	

86 **Falsifying the IPCC's 30,000 ice age delay based on statistical analysis of the Antarctic-to-global climate optima phasing gaps from the last 800,000 years** (which the IPCC omitted to do) **(2)**. Antarctic-to-Global Climate Optima phasing gaps: Data: (1) Jouzel, J., V. et al. 2007. "Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years." Science, Volume 317, No. 5839, 793-797, 10 August 2007. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. EPICA Dome C - 800KYr Deuterium Data and Temperature Estimates. https://www.ncdc.noaa.gov/paleo/study/6080. Download data: Downloaded 08/02/2016. (2) R. Bintanja and R.S.W. van de Wal, North American ice-sheet dynamics and the onset of 100,000-year glacial cycles. Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015. Analysis: The data is tabulated below and details 787,300 years of **Antarctic-to-global climate optima phasing gaps** (Kiloyears). A Grubb's test was performed on the Antarctic-to-global climate optima phasing gaps to determine if the IPCC's proposed 30,000 year ice age delay created a statistically significant outlier from the other 8 glacial cycle comparator phasing gaps (Antarctica versus global; glacial cycles 1-9). By delaying the Holocene Climate Optima 30,000 years, the phasing gap changes from the current 8,400 years to a statistically significant outlier at 40,500 years (P<0.05)(40,500 years =30,000+2,100+8,400 years). The 30,000-year phasing gap increase was only applied to the global climate data's climate optimum because Antarctica's climate optimum was set in the ice record 10,500 years ago and new ice has accumulated since, indicating its ice age has already started (i.e., the inner domes are 100 meters higher today than it was at the Holocene Climate Optimum). A goodness of fit test was performed with the original data using the d'Agostino-Pearson test: P = 0.678, indicating the original group was not different from a Gaussian or normal distribution. On this basis the Grubbs test was selected to test for an outlier. By delaying the Holocene 30,000 years the phasing gap was increased to 40,500 years and the d'Agostino-Pearson test: P< 0.001. This 30,000-year interglacial extension also changed the data-population distribution from a normal to a non-normal distribution. This change in data distribution adds further support that the 30,000-year delay can not be statistically justified.

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Antarctic Climate Optima (Kiloyears ago)	10.5	128.7	242.1	333.3	406.9	488.6	615.1	693.5	787.3
Global Climate Climate (Kiloyears ago)	2.1	124.8	241.3	329.4	403.5	492.2	612.4	697.9	783.0
Phasing gap (Antactic -v- Global)(Kiloyears)	8.4	3.9	0.8	3.9	3.4	-3.6	2.7	-4.4	4.3
Revised phasing gap (Antactic -v- Global)(Kiloyears)	40.5	3.9	0.8	3.9	3.4	-3.6	2.7	-4.4	4.3

87 **Falsifying the IPCC's 30,000 ice age delay based on statistical analysis of the global interglacial period durations from the last one million years** (which the IPCC omitted to do) **(3)**. Interglacial Interval Extension: Data: Bintanja, R. and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015. Analysis: The first 965,300 years of **global interglacial periods** (Kiloyears) were extracted from the global data to determine their durations. A Grubb's test was performed to determine if the IPCC's proposed 30,000-year extension to the Holocene interglacial period created a statistically significant outlier in this group of ten glacial cycle comparators. To test the statistical validity, the current interglacial duration of 17,500 years (19,600 to 2,100 YBP) was extended by 30,000, plus 2,100 years from its existing climate optimum peak to bring it up to today, yielding a revised 49,600 year interglacial period. By extending this current interglacial by 30,000 years the group interglacial duration mean was 21.1Kyr, standard deviation 11.2Kyr, N=11, and an outlier was detected (two-sided P<0.05). The critical value of Z = 2.35. A goodness of fit test was performed with the original data using the d'Agostino-Pearson test: P = 0.386, indicating the original group was not different from a Gaussian or normal distribution. On this basis the Grubbs test was selected to test for an outlier. By delaying the Holocene 30,000 years the interglacial period was extended to 49,600 years and the d'Agostino-Pearson test: P = 0.011. This 30,000 year interglacial extension changed the data-population distribution to a non-normal or non-Gaussian distribution. This change in data distribution adds further support that the 30,000-year delay can not be statistically justified. The complexities linked to the 492.2Kyr bi-phasic/amputated sub-peak mean this was removed from the analysis (i.e., this interglacial period contains a prior "amputated" peak inserted into the interglacial period that confuses matters, which is similar to the Dome-C data. This interglacial period was therefore removed from the analysis).

Climate Optimum Peak	**2.1Kyr**	**124.8 Kyr**	**241.3 Kyr**	**329.4 Kyr**	**403.5 Kyr**	**492.2 Kyr**	**612.4 Kyr**	**697.9 Kyr**	**783 Kyr**	**859.2 Kyr**	**957.1 Kyr**
Interglacial duration (Kiloyears)	17.5	16.6	11.2	15.2	30.9		18.9	22.6	20.3	21.8	8.2
Climate Optimum Peak	**Delay**	**124.8 Kyr**	**241.3 Kyr**	**329.4 Kyr**	**403.5 Kyr**	**492.2 Kyr**	**612.4 Kyr**	**697.9 Kyr**	**783 Kyr**	**859.2 Kyr**	**957.1 Kyr**
Interglacial duration (Kiloyears)	49.6	16.6	11.2	15.2	30.9		18.9	22.6	20.3	21.8	8.2

88 D. H. Tarling, "Milankvitch Cycles in Climate Change." Geology and Geophysics. Proc. 6th International Symposium on Geophysics, Tanta, Egypt (2010), 1- 8.

89 Mark A. Maslin and Andy J. Ridgwell, "Mid-Pleistocene revolution and the 'eccentricity myth'." Geological Society, London, Special Publications, 247, 19-34, 1 January 2005, https://doi.org/10.1144/GSL.SP.2005.247.01.02. Available online at http://sp.lyellcollection.org/content/247/1/19.

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91 J. A. Rial, 2004, "Earth's orbital eccentricity and the rhythm of the Pleistocene ice ages: The concealed pacemaker." Global and Planetary Change, 41(2), 81-93. DOI:10.1016/j.gloplacha.2003.10.003.

92 J. Kirkby et al., "The glacial cycles and cosmic rays." CERN-PH-EP/2004-027. https://arxiv.org/abs/physics/0407005.

93 Gerald E. Marsh, "Interglacials, Milankovitch Cycles, and Carbon Dioxide." DOI: 10.1155/2014/345482. Available at https://arxiv.org/abs/1002.0597.

94 **WG1 (AR4) tells us the Milankovitch theory of ice ages is now well developed.** IPCC, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pages [See pages 56 and 85; **(1)** Page 56, Box TS.6. "*The Milankovitch, or 'orbital' theory of the ice ages is now well developed. Ice ages are generally triggered by minima in high-latitude NH summer insolation, enabling winter snowfall to persist through the year and therefore accumulate to build NH glacial ice sheets. Available evidence indicates that the current warming will not be mitigated*

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by a natural cooling trend towards glacial conditions. *Understanding of the Earth's response to orbital forcing indicates that the* ***Earth would not naturally enter another ice age for at least 30,000 years.*** *{6.4, FAQ 6.1}.*" (**2**) Page 85 section TS.6.2.4 Paleoclimate under "***Robust Findings***" "***It is very unlikely that the Earth would naturally enter another ice age for at least 30,000 years***. *{6.4}*")].

95 **Tabulated data** of the Antarctic, Arctic, and global inter-climate optimum intervals and the phasing gaps between the corresponding global and Antarctic climate optima. **Dome C data**: J. V. Jouzel et al., 2007, "Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years." Science, Volume 317, No. 5839, 793-797, 10 August 2007. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. EPICA Dome C - 800KYr Deuterium Data and Temperature Estimates. https://www.ncdc.noaa.gov/paleo/study/6080. Download data: Downloaded 08/02/2016. **Global data**: R. Bintanja and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158.

Climate Reconstruction Location (Polar, Global)	GLACIAL CYCLE CLIMATE OPTIMA TIMINGS & PHASING (Kiloyear)											Mean	Stdev
Antarctica climate optima timing (Dome-Fuji)(Uemura, R et al.)	10.1	131.9	243.3	336.1									
Climate optima interval (Dome Fuji)	121.8	111.4	92.8									108.7	
Antarctica Dome EPICA-C climate optima timing (Jouzel et al.)	10.5	128.7	242.1	333.3	406.9	488.6	615.1	693.5	787.3				
Climate optima interval (EPICA Dome-C)	118.1	113.4	91.2	73.6	81.7	126.5	78.5	93.8				97.1	19.8
Arctic-Greenland climate optima timing (Sigfus J. Johnsen et al.)	9.4	127.0											
Greenland climate optima interval	117.6												
Arctic-Greenland climate optima (B. M. Vinther, et al.)	8.0												
Global climate optima timing (Bintanja) timing	2.1	124.8	241.3	329.4	403.5	492.2	612.4	697.9	783.0	859.2	957.1		
Global climate optima interval	122.7	116.5	88.1	74.1	88.7	120.2	85.5	85.1	76.2	97.9	66.5	92.9	19.2
Dome EPICA-C to Global climate optima phasing gap	8.43	3.86	0.77	3.88	3.36	-3.64	2.66	-4.39	4.30				
Dome-Fuji to Global climate optima phasing gap	8.00	7.10	2.00	6.70									

96 **Extreme outlier Arctic warming oscillations fall abruptly upon switching phase to their cooling mode**. Data: (1) B.M. Vinther et al., 2009, "Holocene thinning of the Greenland ice sheet." Nature, Vol. 461, pp. 385-388, 17 September 2009. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Greenland Ice Sheet Holocene d18O, Temperature, and Surface Elevation. doi:10.1038/nature08355. https://www.ncdc.noaa.gov/paleo-search/study/11148. Downloaded 05/05/2018. Analysis: Groups 1 and 2 previously defined in end note citation 34 were compared by their magnitudes of decline from the temperature peak to see if there was a difference between them once the climate switched to a cooling phase. The time to reach the first post-peak trough, and to their maximum troughs was calculated. Each group of peak to trough decline phases had a normal distribution (d'Agostino-Pearson test and Shapiro-Wilks test: P>0.05) but a different variance. As such a Welch T-test (unpaired) was used to assess group differences. Results: Group 1 (≥1.77°C trough-to-peak) showed a mean temperature decline at the 1st trough after the main peak of 1.92°C versus Group 2's (≤1.77°C trough-to-peak) mean temperature decline of 1.03°C. This Group 2 decline represented a statistically significant difference in temperature decline over Group 1 (2-tailed P-value = 0.043). Group 1 showed a mean temperature decline at the maximum trough after the peak of 1.92°C versus Group 2's mean temperature decline of 1.23°C, but this difference was not significantly different (-0.69°C, P-value 0.08). Moreover, Group 1 rapidly declined such that its first post-peak trough was the same as its maximum trough i.e., **Group 1 temperature fell abruptly**. Group 2 showed a difference between its first and maximum trough of -0.20°C, which was significantly different from its first post-peak trough (P-value = 0.002). Group 1 took 45 years on average to drop -1.92°C with its first and maximum trough being the same (-1.92°C). By contrast, Group 2 took an average of 36 years to reach its first trough and 63 years to reach its deepest trough. Conclusion: The higher the preceding trough-to-peak temperature rise (i.e., a statistical outlier, high temperature peak, or large warming phase) **the greater and more abrupt the temperature falls to near its maximum trough when the climate switches to its cooling mode**.

97 **Data:** R. Bintanja and R.S.W. van de Wal, "North American ice-sheet dynamics and the onset of 100,000-year glacial cycles." Nature, Volume 454, 869-872, 14 August 2008. doi:10.1038/nature07158. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions. https://www.ncdc.noaa.gov/paleo-search/study/11933. Downloaded 10/27/2015. Personal Research: The temperature data for the first 2,100 years after the climate optimum was extracted for the last 34 glacial cycles. This temperature time-series was rebased to zero degrees and zero time so all glacial cycles could be compared on the same basis, i.e., from their peaks. The temperature declined by 0.61°C after the Holocene Climate Optimum (HCO), which was 1.26°C above the average of all other

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glacial cycles in 2,026,800 years. The current glacial cycle's slow decline since the HCO was not a significant outlier in the group.

98 **Data**: J.V. Jouzel et al., 2007, "Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years." Science, Volume 317, No. 5839, 793-797, 10 August 2007. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. EPICA Dome C - 800KYr Deuterium Data and Temperature Estimates. https://www.ncdc.noaa.gov/paleo/study/6080. Download data: Downloaded 08/02/2016. Personal Research: The global temperature for this current ice age inception has declined 1.2°C since the Holocene Climate Optimum (HCO) 10,500 years ago. By contrast, the temperature had declined by an average of 4.3°C 10,500 years after the climate optimum for all eight previous glacial cycles from the last 800,000 years. The current glacial cycle's slow decline after the HCO was not a significant outlier in the group.].

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100 **The IPCC acknowledge that solar and volcanic activity contributed substantially to the LIA's climate change, yet ignored this science in their forecasts and key-risk assessment.** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See Pages 37, "*Based on the comparison between reconstructions and simulations, there is* ***high confidence that not only external orbital, solar and volcanic forcing,*** *but also internal variability,* ***contributed substantially*** *to the spatial pattern and timing of surface temperature changes between the Medieval Climate Anomaly and the Little Ice Age (1450–1850). {5.3.5, 5.5.1}.*" "*There is high confidence for* ***droughts during the last millennium of greater magnitude and longer duration than those observed since the beginning of the 20th century*** *in many regions. There is medium confidence that more megadroughts occurred in monsoon Asia and* ***wetter conditions prevailed in arid Central Asia and the South American monsoon region during the Little Ice Age*** *(1450–1850) compared to the Medieval Climate Anomaly (950–1250). {5.5.4, 5.5.5}.*" See page 77 "***It is very unlikely that NH temperature variations from 1400 to 1850 can be explained by internal variability alone****. There is medium confidence that external forcing contributed to Northern Hemispheric temperature variability from 850 to 1400 and that* ***external forcing contributed to European temperature variations over the last centuries****. {5.3.5, 5.5.1, 10.7.2, 10.7.5; Table 10.1}.*" Page 112 Floods and Droughts: "*On millennial time scales, there is high confidence that proxy information provides evidence of droughts*

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of greater magnitude and longer duration than observed during the 20th century in many regions. There is medium confidence that ***more megadroughts occurred in monsoon Asia and wetter conditions prevailed in arid Central Asia and the South American monsoon region during the Little Ice Age (1450 to 1850)*** *compared to the Medieval Climate Anomaly (950 to 1250). {2.6.2, 5.5.4, 5.5.5, 10.6.1}*." See Page 408 "*The median of the NH temperature reconstructions (Figure 5.7) indicates mostly warm conditions from about 950 to about 1250 and* ***colder conditions from about 1450 to about 1850****; these time intervals are chosen here to represent the MCA and the LIA, respectively*." See page 885, "*There is medium confidence that* ***both external solar and volcanic forcing, and internal variability, contributed substantially*** *to the spatial patterns of surface temperature changes between the MCA and the LIA, but very low confidence in quantitative estimates of their relative contributions (Sections 5.3.5.3 and 5.5.1). The* ***combined influence of volcanism, solar forcing*** *and a small drop in greenhouse gases (GHGs)* ***likely contributed to Northern Hemisphere cooling during the LIA*** *(Section 10.7.2). Solar radiative forcing (RF) from the Maunder Minimum (1745) to the satellite era (average of 1976–2006) has been estimated to be +0.08 to +0.18 W m–2 (low confidence, Section 8.4.1.2). This may have contributed to early 20th century warming (low confidence, Section 10.3.1)*." See Page 918, "*Detection and attribution studies support results from modelling studies that infer a strong role of external forcing in the cooling of NH temperatures during the Little Ice Age (LIA; see Chapter 5 and Glossary)*." See page 1151, "*The combined records indicate that* ***a net decline of global glacier volume began in the 19th century, before significant anthropogenic RF had started****, and was probably the result of warming associated with the termination of the Little Ice Age (Crowley, 2000; Gregory et al., 2006, 2013b).*"]

101 Wolf minimum (1280-1350), Spörer (1450-1550 CE), Maunder (1645-1715 CE), Dalton (1790-1830 CE).

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148 **WG1 dismissed the prospect of abrupt climate change (linked only to its anthropogenic global warming scenarios)**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate

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Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See Page 70, "TFE.5. **Irreversibility and Abrupt Change**. *"There is information on potential consequences of some abrupt changes, but in general there is low confidence and little consensus on the likelihood of such events over the 21st century. Examples of components susceptible to such abrupt change are the strength of the* ***Atlantic Meridional Overturning Circulation (AMOC), clathrate methane release****, tropical and boreal forest dieback, disappearance of summer sea ice in the Arctic Ocean, long-term drought and monsoonal circulation."* See page 84 *"TS.5.4.7 Possibility of Near-term Abrupt Changes in Climate: There are various mechanisms that could lead to changes in global or regional climate that are abrupt by comparison with rates experienced in recent decades.* ***The likelihood of such changes is generally lower for the near term than for the long term.*** *For this reason the relevant mechanisms are primarily assessed in the TS.5 sections on long-term changes and in TFE.5. {11.3.4}"* See page 1114, "*Section 12.5.5 Potentially Abrupt or Irreversible Changes: This report adopts the definition of abrupt climate change used in Synthesis and Assessment Product 3.4 of the U.S. Climate Change Science Program CCSP (CCSP, 2008b)."* See page 1115, "*Table 12.4: Components in the Earth system that have been proposed in the literature as potentially being susceptible to abrupt or irreversible change. Column 2 defines whether or not a potential change can be considered to be abrupt under the AR5 definition. Column 3 states whether or not the process is irreversible in the context of abrupt change, and also gives the typical recovery time scales. Column 4 provides an assessment, if possible, of the likelihood of occurrence of abrupt change in the 21st century for the respective components or phenomena within the Earth system****, for the scenarios considered in this chapter****.*" **NB**: Under this restrictive definition WG1 only details theoretical abrupt climate change risks relevant to anthropogenic global warming and its CMIP5 modeled scenarios. WG1 **constrained or limited the definition of abrupt climate change**, rather than comprehensively review/analyze the abrupt climate change catastrophes that took place just before and after the Holocene Climate Optimum (HCO) i.e., the **Younger Dryas, the 8.2Kyr, 5.9Kyr, 4.2Kyr rapid climate change events (and others), the Little Ice Age,** and **climate forcing volcanism** throughout the **post-HCO period**.].

149 **Abrupt methane release last happened 55 million years ago. A theoretically irrelevant example of abrupt climate change is detailed, and then dismissed** (irrelevant page fill). IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [Page 70-71, TFE.5, Irreversibility and Abrupt Change. In a theoretical discussion focused only on methane release (from wetlands, permafrost, and ocean hydrates), we are told; *"It is* ***very unlikely*** *that CH4 from clathrates will undergo catastrophic release during the 21st century (high confidence)."* (CH4 = methane)].

150 **Abrupt methane release last happened 55 million years ago. A theoretically irrelevant example of abrupt climate change is detailed, and then dismissed** (irrelevant page fill). IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pages [See page 1079. "*WGI AR5 finds "low confidence in modelling abilities to simulate transient changes in hydrate inventories, but large CH4 release to the atmosphere during this century is unlikely" (WGI AR5 Section 6.4.7.3).*"].

151 Hans Renssen et al., The climatic response to a massive methane release from gas hydrates: Numerical experiments with a coupled climate model. Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam, Netherlands https://www.geo.vu.nl/~renh/methane-pulse.html.

152 **Irrelevant page-filling Dansgaard-Oeschger rapid warming episodes and Heinrich events were reviewed and then dismissed** (i.e., they occur during the depths of an ice age): IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M.

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154 **The 8.2 kiloyear Rapid or Abrupt Climate Change Event only reviewed its warming recovery phase, rather than its catastrophic rapid cooling phase**: IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See page 433, "*The abrupt climate-change event at 8.2 ka* ***permits the study of the recovery time of the AMOC*** *to freshwater perturbation under near-modern boundary conditions (Rohling and Pälike, 2005).*"].

155 **The risk of rapid climate change associated with solar radiation management** (i.e., geoengineering the theoretical anthropogenic global warming). IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pages. [See page 454. "*Termination of SRM after its implementation involves* ***the risk of rapid climate change*** *and more severe effects on ecosystems (Russell et al., 2012).*" SRM = solar radiation management].

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157 R.B. Alley, 2004, "GISP2 Ice Core Temperature and Accumulation Data." National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. https://www.ncdc.noaa.gov/paleo/study/2475. Downloaded 05/05/2018. [The GISP2 ice core highlights a sustained and staged decline in temperature that started prior to the Younger Dryas temperature collapse from 14.5Kyr ago (-31.8°C), and at its deepest trough during the Younger Dryas 12.7Kyr ago the ice core temperature was -50.1°C, **representing a -18.4°C drop in temperature over 1,843 years**. For the period generally referred to as the Younger Dryas the ice core temperature declined rapidly from its sub-peak 13,014 years ago (-41.1°C) **by 9°C within 309 years**.].

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186 **The IPCC's review of the most destructive rapid climate event in the last 13 millennia (i.e., the Younger Dryas) focused on its warming recovery phase.** Part A: IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp. [See page 280. "***Rapid, regional warming before and after the Younger Dryas cooling event (11.7 to 12.9 ka) provides a relatively recent analogy for climate change at a rate approaching, for many regions, that projected for the 21st century for all Representative Concentration Pathways*** *(RCPs; Alley et al., 2003; Steffensen et al., 2008). Ecosystems and species responded rapidly during the Younger Dryas by shifting distributions and abundances, and there were some notable large animal extinctions, probably exacerbated by human activities (Gill et al., 2009; Dawson et al., 2011). In some regions, species became locally or regionally extinct (extirpated), but there is no evidence for climate-driven global-scale extinctions during this period (Botkin et al., 2007; Willis, K.J. et al., 2010). However, the Younger Dryas climate changes differ from those projected for the future because* ***they were regional rather than global; may have only regionally exceeded rates of warming projected for the future;*** *and started from a baseline substantially colder than present (Alley et al., 2003).*"].

187 **The IPCC dismissed the prospect of a rapid AMOC weakening during the 21st century**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [Page 1119. "*Abrupt Saharan vegetation changes of the Younger Dryas are linked with a rapid AMOC weakening which is considered very unlikely during the 21st century and unlikely beyond that as a consequence of global warming.*" **NB:** The IPCC recognize that **rapid AMOC weakening** was associated with **accelerated Saharan desertification**.]

188 **Global warming induced Atlantic Meridional Overturning Circulation (AMOC) collapse is dismissed (i.e., rapid climate change)**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [Exposé; See page 24, Section E4 Ocean. "*It is very unlikely that the AMOC will undergo an abrupt transition or collapse in the 21st century for the scenarios considered*." (With reference to the IPCC's 4 promoted Representative Concentration Pathway global warming scenarios.). See Page 70, "TFE.5. Irreversibility and Abrupt Change. *"Abrupt Climate Change Linked with AMOC New transient climate model simulations* (i.e., theoretical models are prone to assumption errors) *have confirmed with high confidence that strong changes in the strength of the AMOC produce abrupt climate changes at global scale with magnitude and pattern resembling past glacial Dansgaard–Oeschger events and Heinrich stadials." "It also remains very unlikely that the AMOC will undergo an abrupt transition or collapse in the 21st century for the scenarios considered (high confidence) (TFE.5, Figure 1)."* See page 1115,*"**The FIO-ESM model shows cooling over much of the NH** (i.e., Right-click-search-paste) **that may be**

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related to a strong reduction of the AMOC in all RCP scenarios *(even RCP2.6), but the limited output available from the model precludes an assessment of the response and realism of this response. Hence it is not included the overall assessment of the likelihood of abrupt changes."* **NB:** This *FIO-ESM model* dismissal represents confirmation bias, because the model output is at odds with the IPCC's global warming scenarios and the political narrative.].

189 **WG1 dismissed secular changes in solar activity from its climate forecasts (i.e., known cooling factors)**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [Exposé: See page 1009 sub-section 11.3.6.3 point 4 for solar irradiance and volcanism, "*As discussed in Section 11.3.6.2, the RCP scenarios assume* ***no underlying trend in total solar irradiance****." "there is low confidence in projected changes in solar irradiance (Chapter 8). Consequently the possible effects of future changes in natural forcings are excluded from the assessment here*." "See page 56. "*The recent solar minimum appears to have been unusually low and long-lasting and several projections indicate lower TSI for the forthcoming decades. However, current abilities to project solar irradiance are extremely limited so that there is very low confidence concerning future solar forcing. Nonetheless, there is a high confidence that 21st century solar forcing will be much smaller than the projected increased forcing due to WMGHGs. {5.2.1, 8.4.1; FAQ 5.1}*." See page 1007 for how the IPCC dismissed the impact of solar forcing during this grand solar minimum, "*As discussed in Chapter 8 (Section 8.4.1.3), the Sun has been in a 'grand solar maximum' of magnetic activity on the multi-decadal time scale. However,* ***the most recent solar minimum was the lowest and longest since 1920****, and some studies (e.g., Lockwood, 2010) suggest there could be a continued decline towards a much quieter period in the coming decades, but there is low confidence in these projections (Section 8.4.1.3).*" **NB:** This conveniently eliminates any form of natural cooling, that would counter the IPCC's global warming projections = Confirmation bias.].

190 **Atmospheric blocking can cause abrupt AMOC changes**. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See page 1247, Box 14.2 Blocking (Atmospheric blocking). "*At interannual time scales, there are statistically significant relationships between blocking activity and several dominant modes of atmospheric variability, such as the NAO (Section 14.5.1) and wintertime blocking in the Euro-Atlantic sector (Croci-Maspoli et al., 2007a; Luo et al., 2010), the winter PNA (Section 14.7.1) and blocking frequency in the North Pacific (Croci-Maspoli et al., 2007a), or the SAM (Section 14.5.2) and winter blocking activity near the New Zealand sector (Berrisford et al., 2007). Multi-decadal variability in winter blocking over the North Atlantic and the North Pacific seem to be related, respectively, with the Atlantic Meridional Overturning Circulation (AMOC; Häkkinen et al., 2011; Section 14.7.6) and the Pacific Decadal Oscillation (PDO; Chen and Yoon, 2002; Section14.7.3), although this remains an open question. Other important scientific issues related to the blocking phenomenon include the mechanisms of blocking onset and maintenance, two way interactions between blocking and stratospheric processes (e.g., Martius et al., 2009; Woollings et al., 2010), influence on blocking of slowly varying components of the climate system (sea surface temperature (SST), sea ice, etc., Liu et al., 2012b), and* ***external forcings.*** *The most consistent long-term observed trends in blocking for the second half of the 20th century are the reduced winter activity over the North Atlantic (e.g., Croci-Maspoli et al., 2007b), which is consistent with the observed increasing North Atlantic Oscillation (NAO) trend from the 1960s to the mid-1990s (Section 2.7.8), as well as an eastward shift of intense winter blocking over the Atlantic and Pacific Oceans (Davini et al., 2012). The apparent decreasing trend in SH blocking activity (e.g., Dong et al., 2008) seems to be in agreement with the upward trend in the SAM.*"].

191 Lean, J. L. & Rind, D. How will Earth's surface temperature change in future decades? Geophysical Research Letters, 36, L15708 (2009).

192 M.F. Knudsen et al., 2014. Evidence for external forcing of the Atlantic Multidecadal Oscillation since termination of the Little Ice Age. Nature Communications, Volume 5, Article number 3323.

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193 D. Swingedouw et al., Bidecadal North Atlantic ocean circulation variability controlled by timing of volcanic eruptions. Nature Communications volume 6, Article number: 6545 (2015).

194 **Key limitations of CMIP5 models were known to the IPCC (i.e., CMIP5 models do not adequately reflect dynamic responses to climate-forcing volcanism).** S. Driscoll et al., (2012). Coupled Model Intercomparison Project 5 (CMIP5) simulations of climate following volcanic eruptions, J. Geophysical Research, 117, D17105, doi:10.1029/2012JD017607. ["*All available models submitted to the CMIP5 archive as of April 2012 that had a reasonably realistic representation of volcanic eruptions and number of samples have been analyzed for their ability to simulate post-volcanic radiative and dynamic responses. With substantially different dynamics between the models it was hoped to find at least one model simulation that was dynamically consistent with observations, showing improvement since S06. Disappointingly, we found that again, as with S06, despite relatively consistent post volcanic radiative changes, none of the models manage to simulate a sufficiently strong dynamical response.*" NB: This reference **was cited by Working Group 1** on page 833, meaning the limitations of CMIP5 models were known to the IPCC.].

195 **WG1 dismissed the climate forcing impact of volcanic eruptions from its climate forecasts (i.e., known cooling factors).** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See pages 1008-1009, "FAQ 11.2, How Do Volcanic Eruptions Affect Climate and Our Ability to Predict Climate?" While detailing over 1.5 pages about the planetary cooling impact of large magnitude volcanic eruptions we are informed, "***The future projections in this report do not include future volcanic eruptions***." See page 1009 sub-section 11.3.6.3 point 4 for solar irradiance and volcanism, "*As discussed in Section 11.3.6.2, the RCP scenarios assume no underlying trend in total solar irradiance and no future volcanic eruptions. Future volcanic eruptions cannot be predicted and there is low confidence in projected changes in solar irradiance (Chapter 8). Consequently the possible effects of future changes in natural forcings are excluded from the assessment here*." NB: This conveniently eliminated any form of natural cooling, that would counter the IPCC's global warming projections = Confirmation bias.].

196 Armstrong, J. S., Green, K. C., & Soon, W. (2011). Research on Forecasting for the Manmade Global Warming Alarm: Testimony to Committee on Science, Space and Technology Subcommittee on Energy and Environment on "Climate Change: Examining the processes used to create science and policy". Retrieved from http://repository.upenn.edu/marketing_papers/139. [Extracted from the Abstract. "*We conducted a validation test of the IPCC forecasts that were based on the assumption that there would be no regulations. The* ***errors for the IPCC model long-term forecasts (for 91 to 100 years in the future) were 12.6 times larger than those from an evidence-based "no change" model.*** *Based on our own analyses and the documented unscientific behavior of global warming alarmists, we concluded that the* ***global warming alarm is the product of an anti-scientific political movement****. Having come to this conclusion, we turned to the "structured analogies" method to forecast the likely outcomes of the warming alarmist movement. In our ongoing study we have, to date, identified 26 similar historical alarmist movements. None of the forecasts behind the analogous alarms proved correct. Twenty-five alarms involved calls for government intervention and the government imposed regulations in 23.* ***None of the 23 interventions was effective and harm was caused by 20 of them.*** *Our findings on the scientific evidence related to global warming forecasts* ***lead to the following recommendations****:* 1. End government funding for climate change research." 2. End government funding for research predicated on global warming (e.g., alternative energy; CO2 reduction; habitat loss). 3. End government programs and repeal regulations predicated on global warming. 4. End government support for organizations that lobby or campaign predicated on global warming."]

197 Green, K. C., Armstrong, J. S., & Soon, W. (2008). Benchmark Forecasts for Climate Change. Retrieved from http://repository.upenn.edu/marketing_papers/138. [Extracted from the Abstract: "*Climate is complex due to many causal variables and their variable interactions. There is uncertainty about causes, effects, and data.* ***Using evidence-based (scientific) forecasting principles, we determined that a naïve "no change" extrapolation method was the appropriate benchmark****. To be useful to policy makers, a proposed forecasting method would have to provide forecasts that were substantially more accurate than the benchmark. We calculated benchmark forecasts against the UK*

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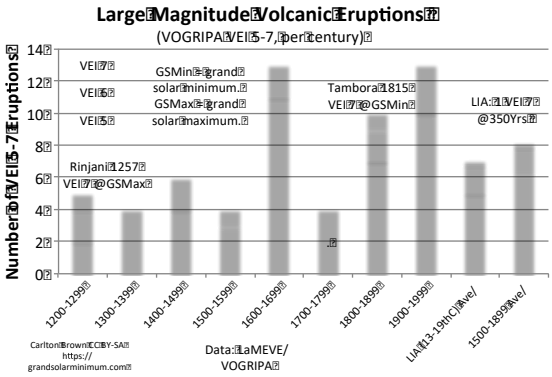
Met Office Hadley Centre's annual average thermometer data from 1850 through 2007. For 20- and 50-year horizons the mean absolute errors were 0.18°C and 0.24°C. The accuracy of forecasts from our naïve model is such that even perfect forecasts would be unlikely to help policy makers. We nevertheless evaluated the Intergovernmental Panel on Climate Change's 1992 forecast of 0.03°C-per-year temperature increases. The small sample of errors from ex ante forecasts for 1992 through 2008 was practically indistinguishable from the naïve benchmark errors. To get a larger sample and evidence on longer horizons we backcast successively from 1974 to 1850. Averaged over all horizons, ***IPCC errors were more than seven times greater than errors from the benchmark****. Relative errors were larger for longer backcast horizons*."]

198 **Climate-forcing volcanism over the last 1,000 years.** Data: (1) Helen Sian Crosweller et al., "Global database on large magnitude explosive volcanic eruptions (LaMEVE)." Journal of Applied Volcanology Society and Volcanoes 20121:4. https://doi.org/10.1186/2191-5040-1-4. Volcano Global Risk Identification and Analysis Project database (VOGRIPA), British Geological Survey. Data Access: http://www.bgs.ac.uk/vogripa/. Data downloaded 07/05/2018.

NUNMBER OF LARGE MAGNITUDE VOLCANIC ERUPTIONS PER CENTURY PERIOD

CENTURY (CE)	VEI 4-7	VEI 4-5	VEI 4	VEI 5	VEI 6	VEI 7
1000-1099	11	10	7	3	1	
1100-1199	9	9	6	3		
1200-1299	14	11	9	2	2	1
1300-1399	15	15	11	4		
1400-1499	14	12	8	4	2	
1500-1599	21	20	17	3	1	
1600-1699	30	28	17	11	2	
1700-1799	36	36	32	4		
1800-1899	41	39	32	7	2	1
1900-1999	56	53	43	10	3	
LIA (13-19thC) Ave/Century	24.4	23.0	18.0	5.0	1.8	0.29
1500-1899 Ave/Century	32	30.75	24.5	6.25	1.7	0.25

VEI; Volcanic Explosivity index (Scale 1-8)



199 **The majority of the post-Holocene Climate Optimum climate-forcing volcanic eruptions (<-5W/m^2) were associated with grand solar minima and maxima.** Data: (1) Takuro Kobashi et al., 2017, "Volcanic influence on centennial to millennial Holocene Greenland temperature change." Scientific Reports, 7, 1441. doi: 10.1038/s41598-017-01451-7. Data provided by the National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. https://www.ncdc.noaa.gov/paleo-search/study/22057. Data accessed 21/08/2018. (2) Solanki, S.K., et al. 2004. "An unusually active Sun during recent decades compared to the previous 11,000 years." Nature, Volume 431, No. 7012, 1084-1087, 28 October 2004. Data: Solanki, S.K., et al. 2005. "11,000 Year Sunspot Number Reconstruction." IGBP PAGES/World Data Center for Paleoclimatology. Data Contribution Series #2005-015. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA. https://www.ncdc.noaa.gov/paleo-search/study/5780. Downloaded 05/06/2018. Analysis: Using the above-cited climate-forcing volcanic eruption data a quantitative filter was utilized to identify the largest climate forcing eruptions, and to group all eruption events into climate-forcing categories for sub-analysis. Each volcanic eruption started with the first data point in a group series, and this group series magnitude was represented by the maximum volcanic forcing magnitude data point in that series (i.e., the most negative Watts/meter-squared value) (i.e., a 1-year value from within a range of 1-10 years). This was completed for the entire time series spanning 11,054 years. In this manner 403 volcanic events were identified over the 11,054 year period. The eruption events were preliminarily assigned to groups based on their maximum solar forcing impact, as follows: Group-1, ≤-10 W/m2 (N=23). Group-2, -5.0 to <-9.99 W/m2 (N=50). Group-3, -2.0 to <-4.99 W/m2 (N=89). Group-4, 0 to <-1.99 W/m2 (N=241). Volcanic events were then grouped and compiled into 500, 400, and 300 year bin totals spanning the last 5,000, 8,000, and 11,000 years. The average sunspot numbers were calculated for each bin period. A goodness of fit and outlier tests were then conducted for all groupings. Pearson and Spearman rank correlations and their significance levels were calculated for each 5,000, 8,000, and 11,000 year periods to help understand if any relationships existed. Results: Slide deck #11 (left graphic): The 500-year bin totals (Group 1 and 2 combined) generated the highest and most significant correlations, and the **8,000** year **period maximized the correlation coefficients**. The correlation values were reduced for the 11,000-year period versus the

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8,000-year period, and were marginally smaller for 400-year bins, and much smaller for 300-year bins (Data not shown) compared with the 500-year bins. On this basis, the 8,000-year duration and 500-year bin totals (Group 1 and 2 eruption events combined) represented the optimum grouping which maximized the correlation and duration of the relationship i.e., **since the Holocene Climate Optimum**. The outcome of this analysis was to compile Groups 1 and 2 into a single group and set the c**limate-forcing eruption threshold at ≤ -5.0 Watts/meter-squared** i.e., 73 climate-forcing volcanic eruptions. All 73 large climate-forcing volcanic eruptions were plotted against the above-cited Solanki et al. sunspot numbers to derive slide deck #11 (left and right graphics): The 73 climate-forcing eruptions selected above were tabulated alongside the above-cited Solanki et al. sunspot numbers in the year of the eruption's occurrence. The number of periods (at a 10-year resolution) was counted to the previous or next big (grand solar) and small (sub-) peak or trough for all eruption events. An eruption was then assigned to a big or little peak or trough based on its closest proximity to one of those events. Fifty-six of 73 eruptions (77%) of volcanic eruptions of more than a -5W/m^2 climate forcing impact, over the last 11,000 years, occurred at or within a decade of a grand solar minimum or maximum of sunspot numbers (i.e., **reconstructed from tree-ring carbon-14 radioisotope, a magnetized solar wind proxy,** see citation 203) and 87% at or within two decades.

200 **Grand solar minimum and maximum extremes of solar activity putatively act as a climate oscillator (via climate-forcing volcanism).** Data: (1) Helen Sian Crosweller et al., "Global database on large magnitude explosive volcanic eruptions (LaMEVE)." Journal of Applied Volcanology Society and Volcanoes 20121:4. https://doi.org/10.1186/2191-5040-1-4. Volcano Global Risk Identification and Analysis Project database (VOGRIPA), British Geological Survey. Data Access: http://www.bgs.ac.uk/vogripa/. Data downloaded 07/05/2018. (2) S.K. Solanki et al., 2004, "An unusually active Sun during recent decades compared to the previous 11,000 years." Nature, Volume 431, No. 7012, 1084-1087, 28 October 2004. Data: S.K. Solanki et al., 2005, "11,000 Year Sunspot Number Reconstruction." IGBP PAGES/World Data Center for Paleoclimatology. Data Contribution Series #2005-015. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA. https://www.ncdc.noaa.gov/paleo-search/study/5780. Downloaded 05/06/2018. Analysis: A total of 67 VEI 6 and 7 eruptions were extracted from the LaMEVE database. These were plotted alongside the above-cited Solanki et al. sunspot numbers. The number of 10-year periods was counted from each eruption to the previous or next sunspot number peak or trough. The data is tabulated above, at the start of the endnotes and referencing this endnote. Results: 82 percent of VEI 6-7 eruptions occurred at or within one decade of a sunspot number peak or trough. This peak and trough occurrence coincides with either a grand solar maximum or minimum, or a smaller sub-peak or sub-trough of sunspot numbers. **NB:** while it is generally recognized the LaMEVE database accuracy falls off, preceding the last millennium (see the next end note's review of this database, https://doi.org/10.1186/2191-5040-3-5), it is interesting that this citation's analysis using the LaMEVE eruption data yielded the same conclusion to the previous citation's analysis (i.e., eruption dates and magnitudes derived from ice core sample chemistry and tree-ring C14 to derive sunspots).

201 S.K. Brown et al., "Characterization of the Quaternary eruption record: analysis of the Large Magnitude Explosive Volcanic Eruptions (LaMEVE) database." J Appl. Volcanology. (2014) 3: 5. https://doi.org/10.1186/2191-5040-3-5.

202 **Large magnitude volcanism's association with the Little Ice Age's grand solar minimum and maximum, and the 8.2Kyr rapid climate change event.** Data: (1) Helen Sian Crosweller et al., "Global database on large magnitude explosive volcanic eruptions (LaMEVE)." Journal of Applied Volcanology Society and Volcanoes 20121:4. https://doi.org/10.1186/2191-5040-1-4. Volcano Global Risk Identification and Analysis Project database (VOGRIPA), British Geological Survey. Data from: http://www.bgs.ac.uk/vogripa/. Data downloaded 07/05/2018. (2) S.K. Solanki et al., 2004, "An unusually active Sun during recent decades compared to the previous 11,000 years." Nature, Volume 431, No. 7012, 1084-1087, 28 October 2004. Data: Solanki, S.K., et al. 2005. 11,000 Year Sunspot Number Reconstruction. IGBP PAGES/World Data Center for Paleoclimatology. Data Contribution Series #2005-015. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA. https://www.ncdc.noaa.gov/paleo-search/study/5780. Downloaded 05/06/2018. (3) Takuro Kobashi et al., 2017, "Volcanic influence on centennial to millennial Holocene Greenland temperature change." Scientific Reports, 7, 1441. doi: 10.1038/s41598-017-01451-7. Data provided by the National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce.

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https://www.ncdc.noaa.gov/paleo-search/study/22057. Data accessed 21/08/2018. Analysis: (1) Slide deck #12 (left graphic): The 11 total VEI 6 and 7 eruptions between 1235 and 1885 were extracted from the LaMEVE database and graphically plotted as discrete events on the above-cited Solanki et al. reconstructed sunspot number data within this same period. In this manner, the occurrence of VEI 6-7 eruptions can be viewed relative to the grand solar maximum or minimum, or going into or coming out of a grand solar minimum trough. This data shows that 5 of the 11 large magnitude volcanic eruptions (VEI 6-7) during the LIA and since Rinjani's grand solar maximum associated eruption (1257 CE), took place at or near the trough of grand solar minima periods. A further 3 of 11 large magnitude volcanic eruptions occurred half way into a grand solar minimum, while the remaining 3 of 11 eruptions occurred at grand solar maximum sunspot number peaks. (2) Slide deck #12 (right graphic): The Solanki sunspot number data was extracted running from a grand solar maxima-to-minima-to-maxima covering the 8.2Kyr rapid climate change event. The corresponding climate forcing volcanic eruptions from the Takuro Kobashi, et al. volcanic eruption data were plotted in the sunspot number periods that they occurred. This data highlights that the 8.2-kiloyear RCC event (associated with an AMOC collapse) took place at or near the trough of a deep grand solar minimum period, which was associated with a cluster of climate-forcing volcanic eruptions (of more than a -5W/m^2 forcing). Conclusion: These 2 slide deck #12 figures highlight the association of large climate-forcing volcanic eruptions with either a grand solar maximum or minimum, or a smaller sub-peak or sub-trough of sunspot numbers going into or coming out of a grand solar minimum period.

203 **Magnetized solar wind is associated with earth system risks**. I.G.M. Usoskin et al., "Solar activity, cosmic rays, and Earth's temperature: A millennium-scale comparison." Journal of Geophysical Research, 110, A10102, doi:10.1029/2004JA010946. [Exposé: See page 1. This tells us cosmogenic isotopes (Beryllium-10, Carbon-14) are used as proxies for solar activity, and that their production is caused by galactic cosmic ray flux, which is influenced by the solar system's (heliospheric) magnetic field and is modulated by solar activity. Comment: Magnetized solar wind modulates the solar system's magnetic shield (i.e., the heliosphere) and the earth's magnetic shield (i.e. the magnetosphere), thereby regulating cosmic ray entry into the solar system and the earth system respectively. Cosmic ray entry into the upper atmosphere from space is modulated by solar activity and geomagnetism. Lower solar activity and lower geomagnetism permit more cosmic ray entry into the atmosphere, and conversely. Increased cosmic ray levels are associated with increased low-cloud formation, which is associated with planetary cooling, and conversely. The cosmic ray and low-cloud cooling effect are concentrated into the polar regions. Cosmogenic isotopes (Carbon-14, Beryllium-10) are generated by cosmic rays in the atmosphere, with more cosmic rays generating more cosmogenic isotopes, and conversely. Cosmogenic isotopes are then embedded in earth repositories (i.e., tree rings, ice cores) and therefore indirectly tell us about solar activity and the resulting magnetized solar wind that contacts the earth's magnetosphere. By utilizing cosmogenic isotopes to assess relationships between the sun and earth systems (i.e., climate and volcanism) we know that the solar activity that is being assessed in this specific situation is mediated by magnetized solar wind].

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233 **The IPCC dismiss**ed **the prospect and impact** of this current **grand solar minimum** that the sun has entered, without any authoritative expertise or credible review of the science and data**.** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages. [See page 1022 Chapter citation mention of “*grand solar minimum*.” See page 1007. “*As discussed in Chapter 8 (Section 8.4.1.3), the Sun has been in a ‘grand solar maximum’ of magnetic activity on the multi-decadal time scale. However, the most recent solar minimum was the lowest and longest since 1920, and some studies (e.g., Lockwood, 2010) suggest there could be a continued decline towards a much quieter period in the coming decades, but there is low confidence in these projections (Section 8.4.1.3). Nevertheless, if there is such a reduction in solar activity, there is high confidence that the variations in TSI RF will be much smaller than the projected increased forcing due to GHGs (Section 8.4.1.3).*” See page 393, “Finally, a decrease in solar activity during the past solar minimum a few years ago (FAQ 5.1, Figure 1b) raises the question of its future influence on climate. Despite uncertainties in future solar activity, there is high confidence that the effects of solar activity within the range of grand solar maxima and minima will be much smaller than the changes due to anthropogenic effects.” **NB:** once again this exemplifies the IPCC’s confirmation bias, while failing to reflect the climate impact of magnetized solar wind.

234 **The IPCC dismisses secular changes in solar irradiance on climate change, while completely ignoring the climate impact of solar magnetism.** IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See page 14. Figure SPM.5 “*Radiative forcing estimates in 2011 relative to 1750 and aggregated uncertainties for the main drivers of climate change. Values are global average radiative forcing (RF14), partitioned according to the emitted compounds or processes that result in a combination of drivers. The best estimates of the net radiative forcing are shown as black diamonds with corresponding uncertainty intervals; the numerical values are provided on the right of the figure, together with the confidence level in the net forcing (VH – very high, H – high, M – medium, L – low, VL – very low). Albedo forcing due to black carbon on snow and ice is included in the black carbon aerosol bar.* ***Small forcings due to contrails (0.05 W m–2****, including contrail induced cirrus), and HFCs, PFCs and SF6 (total 0.03 W m–2) are not shown.” The IPCC assign* ***0.05 W m–2 [0.00 to 0.10] to solar irradiance’s radiative forcing impact (2%)****, and 2.29 W m–2 [1.13 to 3.33] to total anthropogenic causes (98%) relative to 1750*.”]

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236 IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pages [See page 55-56. "*Satellite observations of total solar irradiance (TSI) changes since 1978 show quasi-periodic cyclical variation with a period of roughly 11 years. Longer term forcing is typically estimated by comparison of solar minima (during which variability is least). This gives an RF change of –0.04 [–0.08 to 0.00] Wm–2 between the most recent (2008) minimum and the 1986 minimum. There is some diversity in the estimated trends of the composites of various satellite data, however. Secular trends of TSI before the start of satellite observations rely on a number of indirect proxies. The best estimate of RF from TSI changes over the industrial era is 0.05 [0.00 to 0.10] W m–2 (medium confidence), which includes greater RF up to around 1980 and then a small downward trend. This RF estimate is substantially smaller than the AR4 estimate due to the addition of the latest solar cycle and inconsistencies in how solar RF was estimated in earlier IPCC assessments. The recent solar minimum appears to have been unusually low and long-lasting and several projections indicate lower TSI for the forthcoming decades. However,* ***current abilities to project solar irradiance are extremely limited so that there is very low confidence concerning future solar forcing****. Nonetheless, there is a high confidence that 21st century solar forcing will be much smaller than the projected increased forcing due to WMGHGs. {5.2.1, 8.4.1; FAQ 5.1}*" **NB:** Confirmation bias].

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269 **Magnetized solar wind**. I.G.M. Usoskin et al., “Solar activity, cosmic rays, and Earth’s temperature: A millennium-scale comparison.” Journal of Geophysical Research, 110, A10102, doi:10.1029/2004JA010946 [Exposé, see page 1. This tells us cosmogenic isotopes (Beryllium-10,

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Carbon-14) are used as proxies for solar activity, and that their production is caused by galactic cosmic ray flux, which is influenced by the solar system's (heliospheric) magnetic field and is modulated by solar activity. Comment: Magnetized solar wind modulates the solar system's magnetic shield (i.e., the heliosphere) and the earth's magnetic shield (i.e. the magnetosphere), thereby regulating cosmic ray entry into the solar system and the earth system respectively. Cosmic ray entry into the upper atmosphere from space is modulated by solar activity and geomagnetism. Lower solar activity and lower geomagnetism permit more cosmic ray entry into the atmosphere, and conversely. Increased cosmic ray levels are associated with increased low-cloud formation, which is associated with planetary cooling, and conversely. The cosmic ray and low-cloud cooling effect are concentrated into the polar regions. Cosmogenic isotopes (Carbon-14, Beryllium-10) are generated by cosmic rays in the atmosphere, with more cosmic rays generating more cosmogenic isotopes, and conversely. Cosmogenic isotopes are then embedded in earth repositories (i.e., tree rings, ice cores) and therefore indirectly tell us about solar activity and the resulting magnetized solar wind that contacts the earth's magnetosphere. **By utilizing cosmogenic isotopes** to assess relationships between the sun and earth systems (i.e., climate, volcanism) we know that **the solar activity that is being assessed is magnetism based, and not electromagnetism** (i.e. not solar irradiance).].

270 **Northern Hemisphere temperature and solar activity are significantly correlated since 1400 CE**. Data: **(1)** A.M. Berggren et al., 2009, "A 600-year annual 10Be record from the NGRIP ice core, Greenland." Geophysical Research Letters, 36, L11801, doi:10.1029/2009GL038004. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. North GRIP - 600 Year Annual 10Be Data. https://www.ncdc.noaa.gov/paleo-search/study/8618. Downloaded 05/05/2018. **(2)** T. Kobashi et al., 2013, "Causes of Greenland temperature variability over the past 4000 year: implications for Northern Hemispheric temperature changes." Climate of the Past, 9(5), 2299-2317. doi: 10.5194/cp-9-2299-2013. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Northern Hemisphere 4000 Year Temperature Reconstructions. https://www.ncdc.noaa.gov/paleo/study/15535. Downloaded 05/05/2018. Analysis: **(1)** See slide deck #8: Spearman rank correlation r= -0.76, two-tailed P-value = <0.00001, N=484 annual pairings. Both the Northern Hemisphere temperature and the 18-year moving average Beryllium-10 concentration anomaly anomalies were not normally distributed, though they did not contain outliers. A scatter plot of the data indicated a linear relationship. A Spearman rank correlation was utilized given the non-normal distributions. The correlation was optimized using an 18-year moving average Beryllium-10 concentration anomaly. This 18-year moving average was selected using the scatterplot trend line in Microsoft Excel to maximize the R-squared (versus an 11-year, 5-year, and no moving average). **(2)** See slide deck #8: A Spearman rank correlation r= -0.876, two-tailed P-value = <0.00001, N=205 annual pairings. A Pearson correlation r= -0.91, two-tailed P-value = <0.00001, N=205. The grand solar minima temperature decline phases and their corresponding 18-year trailing average Beryllium-10 data were extracted from the full data set and compiled into a single time series (as linked sequential periods). Each grand solar minimum period was analyzed as a stand-alone grand solar minimum data set (Data not shown) and as fusion of four grand solar minima. The results and conclusion are the same. The temperature data is normally distributed. The 18-year moving average Beryllium-10 concentration anomaly is not normally distributed, indicated by a d'Agostino-Pearson test that yielded a p=0.019, indicating a non-normal distribution. However, the scatter plot demonstrates a linear relationship, and there were no outliers. The correlation was optimized using a 18-year moving average Beryllium-10 concentration anomaly, selected using the scatterplot trend line in Microsoft Excel to maximize the R-squared (versus an 11-year, 5-year, and no moving average). Note: A Pearson correlation was also calculated for both data sets, yielding a similar level of correlation, statistical significance, and the same conclusion (Data not shown). Discussion: This above described relationship tells us the temperature lagged behind the rise in solar activity (viz., a declining Beryllium-10). The use of an 18-year moving average for the Beryllium-10 concentration anomaly means the temperature, in reality, lagged behind fluctuations in the Beryllium-10 concentration anomaly by at least one 11-year solar cycle. This 11-year solar cycle lag (approximate) is composed of 9 years (i.e., half of a 18-year moving average), plus a two year lag in the temperature rise in the raw data (behind the Beryllium-10 rise), plus one year before the newly produced Beryllium-10 in the upper atmosphere reaches earth's surface where it was incorporated

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into Arctic ice cores (and thus be measured). These two parameters also tracked one another's variations, putatively supporting a cause-and-effect relationship.

271 F. Lehner et al., 2013, "Amplified inception of European Little Ice Age by sea ice–ocean–atmosphere feedbacks." J. Climate, 26, 7586–7602. https://doi.org/10.1175/JCLI-D-12-00690.1.

272 Odd Helge Otterå et al., "External forcing as a metronome for Atlantic multidecadal variability." Nature Geoscience Volume 3, 688–694 (2010).

273 Y. Zhong et al., "Centennial-scale climate change from decadally-paced explosive volcanism: a coupled sea ice-ocean mechanism." Climate Dynamics (2011) 37: 2373. https://doi.org/10.1007/s00382-010-0967-z.

274 J. Slawinska and A. Robock, 2018, "Impact of Volcanic Eruptions on Decadal to Centennial Fluctuations of Arctic Sea Ice Extent during the Last Millennium and on Initiation of the Little Ice Age." J. Climate, 31, 2145–2167, https://doi.org/10.1175/JCLI-D-16-0498.1.

275 C. Newhall et al., 2018, "Anticipating future Volcanic Explosivity Index (VEI) 7 eruptions and their chilling impacts." Geosphere, v. 14, no. 2, p. 1–32, doi:10.1130/GES01513.1.

276 V. Bucha, "Geomagnetic activity and the North Atlantic Oscillation." Studia Geophysica et Geodaetica. July 2014, Volume 58, Issue 3, 461–472. https://doi.org/10.1007/s11200-014-0508-z.

277 J. G. Pinto and C. C. Raible, 2012, "Past and recent changes in the North Atlantic oscillation." WIREs Climate Change, 3: 79-90. doi:10.1002/wcc.150.

278 Jesper Olsen et al., "Variability of the North Atlantic Oscillation over the past 5,200 years." Nature Geoscience Volume 5, 808–812 (2012). DOI: 10.1038/NGEO1589.

279 P. Thejll et al., "On correlations between the North Atlantic Oscillation, geopotential heights, and geomagnetic activity." Geophysical Research Letters, 30 (6), 1347, 2003. doi:10.1029/2002GL016598.

280 J.W. Hurrell et al., 2013, "An Overview of the North Atlantic Oscillation." In The North Atlantic Oscillation: Climatic Significance and Environmental Impact (eds J. W. Hurrell, Y. Kushnir, G. Ottersen and M. Visbeck). doi:10.1029/134GM01.

281 A. Mazzarella and N. Scafetta, 2012, "Evidences for a quasi 60-year North Atlantic Oscillation since 1700 and its meaning for global climate change." Theoretical Applied Climatology 107, 599-609. DOI: 10.1007/s00704-011-0499-4.

282 T. Bradwell et al., 2006, "The Little Ice Age glacier maximum in Iceland and the North Atlantic Oscillation: evidence from Lambatungnajökull, southeast Iceland." Boreas, 35: 61-80. doi:10.1111/j.1502-3885.2006.tb01113.x.

283 Jesper Olsen et al., "Variability of the North Atlantic Oscillation over the past 5,200 years." Nature Geoscience Volume 5, 808–812 (2012). DOI: 10.1038/NGEO1589.

284 M.H. Ambaum and B.J. Hoskins, 2002, "The NAO Troposphere–Stratosphere Connection." J. Climate, 15, 1969–1978, https://doi.org/10.1175/1520-0442(2002)015<1969:TNTSC>2.0.CO;2.

285 V. Bucha, "Geomagnetic activity and the North Atlantic Oscillation." Studia Geophysica et Geodaetica. July 2014, Volume 58, Issue 3, 461–472. https://doi.org/10.1007/s11200-014-0508-z.

286 P. B. Thejll et al., "On correlations between the North Atlantic Oscillation, geopotential heights, and geomagnetic activity." Geophysical Research Letters, 30 (6), 1347, 2003. doi:10.1029/2002GL016598.

287 H. Lu et al., 2008, "Possible solar wind effect on the northern annular mode and northern hemispheric circulation during winter and spring." Journal of Geophysical Research, 113, D23104, doi: 10.1029/2008JD010848.

288 V. Bucha, "Geomagnetic activity and the North Atlantic Oscillation." Studia Geophysica et Geodaetica. July 2014, Volume 58, Issue 3, 461–472. https://doi.org/10.1007/s11200-014-0508-z.

289 J.W. Hurrell et al., 2013, "An Overview of the North Atlantic Oscillation." In The North Atlantic Oscillation: Climatic Significance and Environmental Impact (eds J. W. Hurrell, Y. Kushnir, G. Ottersen and M. Visbeck). doi:10.1029/134GM01.

290 Gerard Bond et al., Persistent Solar Influence on North Atlantic Climate During the Holocene. Science, Dec 2001, Vol. 294, Issue 5549, pp. 2130-2136. DOI: 10.1126/science.1065680. [**Solar activity**: The solar activity connection to ice rafting debris was mediated **via a magnetized solar wind mechanism**, determined from Carbon-14 and Beryllium-10 radioisotope proxies. **Ice rafting debris**: The petrologic tracers of drift ice were detrital carbonate, fresh volcanic glass from Iceland,

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and hematite-stained grains (HSG), expressed as percentages of lithic grains in the 63- to 150-mm size range.

291 **Publications used to create a database of influenza pandemic outbreaks since 1500 CE**. Publications: (1) David M. Morens* and Jeffery K. Taubenberger. Pandemic influenza: certain uncertainties. Rev. Med. Virol. 2011; 21: 262–284. DOI: 10.1002/rmv.689. (2) Svenn-Erik Mamelund. Influenza, Historical. December 2008. International Encyclopedia of Public Health, First Edition (2008), vol. 3, pp. 597-609. DOI: 10.1016/B978-012373960-5.00372-5. (3) J.K. Taubenberger(1),* and D.M. Morens(2). Pandemic influenza – including a risk assessment of H5N1. Rev Sci Tech. 2009 April ; 28(1): 187–202. (4) David M. Morens, Jeffery K. Taubenberger. Historical thoughts on influenza viral ecosystems, or behold a pale horse, dead dogs, failing fowl, and sick swine. (5) Bruno Lina. Chapter 12: History of Influenza Pandemics. In: Raoult D., Drancourt M. (eds) Paleomicrobiology. Springer, Berlin, Heidelberg. © Springer-Verlag Berlin Heidelberg 2008. (6) C.W. Potter. A history of influenza. Journal of Applied Microbiology 2001, 91, 572-579. (7) Eugenia Tognotti. Emerging Problems in Infectious Diseases Influenza pandemics: a historical retrospect. J Infect Dev Ctries 2009; 3(5):331-334. Summary: Information from each publication was tabulated into categories according to; the year(s) since 1500CE, the expert's categorization (i.e., a pandemic or an epidemic), geographical origin and its expansion (i.e., country, region, continent, routes of dissemination), and publication notes linked to epidemiological factors (i.e., confirmation of influenza-like symptoms, attack and mortality rates, demographics, ±animal species epizootics &/or zoonosis confirmed). Two broad categories were initially created from the tabulated data for initial screening; (i) Category A (77.4%): this included all confirmed pandemics (>2 continents ±zoonosis), possible pandemics (classified by the cited authors), and any epidemics associated with a zoonosis/epizootic. Where multiple reviewers conflicted in their classification, then geographical data was used to finalize category selection where possible, or a consensus of the majority of cited authors was utilized. Of all the zoonosis/epizootic-linked outbreaks, 81.3% were associated with equine, 12.5% with swine, and 6.3% with avian originating viruses. (ii) Category B (22.6%): this included all epidemics (i.e., national, trans-regional, one continent). Questions are raised regarding some of the event classifications because epidemics bias the 1500-1799 period, whereas pandemics bias the 1700-1999 period. Epidemics could have actually been pandemics, but for the lack of historical records from more than one continent (i.e., Category B events averaged 1.4 authors per classification, whereas Category A events averaged 3.5 authors per classification). Lending further credence to this historical record bias is the fact that epidemics and pandemics both follow the same high percentage association with the peaks and troughs (±1 year) of the 11-year solar cycle. This peak and trough relationship for pandemics and epidemics is embedded within the total solar irradiance, cosmic rays, and sunspot number data. On this basis category A and B events were pooled for all analysis. This pooling was justified by the aforementioned, and all influenza epidemics and pandemics share the same epidemiological features i.e., there is an emergence of a novel virus involving viral mutation, usually coming from animals and/or associated with influenza epizootics (i.e., in equine, swine, avian species), and occurring in a human population or demography devoid of protective immunity (i.e., young or old). The above categorization yielded the following tabulated century-period event distributions, and a subsequent list of all categorized outbreak events.

Category of Event	Pandemics, Epidemics with Zoonosis	Epidemics only	All Events
1500-1599	4	3	7
1600-1699	6	4	10
1700-1799	11	4	15
1800-1899	12	1	13
1900-1999	7		7
2000-2019	1		1
Total	41	12	53

	# Events per century	Interval between events (Yrs) per century group	Interval between events (Yrs) pre-1900 & post-1900	
1500-1599	7	14.3		
1600-1699	10	10.0		
1700-1799	15	6.7		
1800-1899	13	7.7	8.9	1500-1899
1900-1999	7	14.3	14.3	1900-1999
2000-2019	1	20.0		
All periods	53	9.8		

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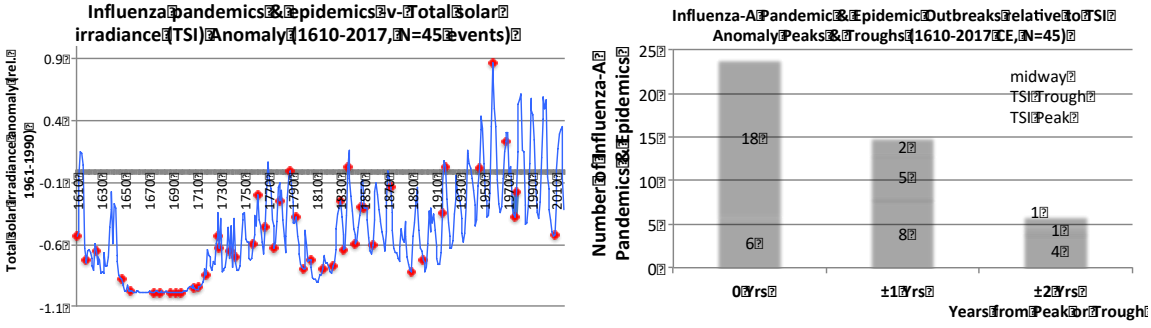
YEAR (Event Start)	YEAR(S)	CLASSIFICATION (incl. Zoonosis)	FINAL CLASSIFICATION	CATEGORY (A&B)	EXTRACTED PUBLICATION Author Expert Reviewers (1-7)	EPIDEMIOLOGY NOTES (numbering refers to	GEOGRAHICAL RESTRICTION	AUTHOR OR CB CONFIRMED CLASSIFICATION	No. # of Publications used to verify classifciation
1510	1510	1	1	A	P [≥2 continents; Africa, Europe 5 to N), plus pan-regional(1,3,6), high at	≥2 continents	yes	5
1557	1557-8	1	1	A	P [≥2 continents; global asia, Europe, High fatalities linked to LRTI [3]]. Ci	≥2 continents	yes	5
1580	1580	1	1	A	P [≥2 continents; global, asia origin, Europe (northward direction, 6mth), i	≥2 continents	yes	7
1767	1767-68	1	1	A	P [≥2 continents; Europe/North America origin (2). Russia, Britain, Siberia(	≥2 continents	≥2 continents cited	2
1780	1780-82	1	1	A	P [≥2 continents; Asia, Russia, and Europe (1,2,3,5,6), Nth america (5), the	≥2 continents	≥2 continents/glob	6
1788	1788-90	1	1	A	P [≥2 continents; Asia origin (3) Russia & Ukraine (2), Europe and northern	≥2 continents	yes (2/3 classified,	3
1805	1805-07	1	1	A	P [≥2 continents; West Indies, Europe, USA (2). Mentioned troop movem	≥2 continents	≥2 continents cited	1
1830	1830-31	1	1	A	P [≥2 continents; SE Asia to Russia to Europe (3,6), China or Russia origin(	≥2 continents	≥2 continents cited	4
1833	1832-33	1	1	A	P [≥2 continents; Asia, Russia, Europe (1,2,6), India (2). Rel. high mortality	≥2 continents	yes	3
1836	1836-37	1	1	A	P [≥2 continents; Russia origin (3). Europe (3) France (5). Rel. high moratalit	≥2 continents	≥2 continents cited	4
1847	1847-48	1	1	A	P [≥2 continents; Russia origin (2), Europe and Western Hemisphere incl. I	≥2 continents	≥2 continents cited	4
1918	1918-19	1	1	A	P [≥2 continents; China, or USA, or Europe origin (1,2,3,4,5,6,7)??. High m	≥2 continents	yes	7
1968	1968-69	1	1	A	P [≥2 continents; China origin (2), SE Asia, Russia, Europe, to global spread	≥2 continents	yes	7
1977	1977-78	1	1	A	P [China or Russia origin (2,5), Siberia (3,4), Euro-Russia frontiers (3,4), limit	≥2 continents	yes	4
1529	1529	2	2	A	P [possible pandemic (2)]. Cited by; 2. Multiple citations provided; 2.	NS	yes	1
1737	1737-38	2	2	A	P [≥2 continents; pronounced global influenza activity (3), America, then E	≥2 continents	yes. CB: ≥2 contine	1
1742	1742-44	2	2	A	P [trans-regional; Europe (3). Possible pandemic (2; multiple citations). Hig	trans-regional	yes. CB: multiple cit	2
1757	1757-58	2	2	A	P? [≥2 continents; Americas, Europe (2)]. Cited by; 2. Provided multiple ci	≥2 continents	≥2 continents cited	1
1775	1775-76	2	2	A	P [trans-regional; Europe and Britain (2,5). High attack rates and low mort	trans-regional	CB: 1 (2/4 citations	4
1799	'99-1803	2	2	A	P [≥2 continents; Russia, Eastern Europe (troop movements during the na	≥2 continents	≥2 continents cited	4
1815	1815-17	2	2	A	P? [possible pandemic (2). France (5). The year of Tambora's eruption VEI 7	NS	yes (1/2 classified a	2
1843	1843	2	2	A	P [author categorized as pandemic (7)]. Cited by; 7.	NS	yes	1
1850	1850-51	2	2	A	P? [SA America origin (2)]. Cited by; 2. Multiple citations provided; 2	trans-regional	yes (multiple citatic	1
1857	1857-58	2	2	A	P [panama origin (2). Pandemic classification (7), possible pandemic (2)]. Ci	NS	yes (1/2 classified a	2
1946	1946	2	2	A	P [possible pandemic (2)]. Cited by; 2.	NS	yes	1
1551	1551	3	3	B	E [epidemic classification only (2)]. Cited by; 2. Multiple citations provide	NS	yes	1
1587	1587	3	3	B	E [trans-regional 1..e, Europe. 2 non-bordering countries cited]. Cited by; 2	trans-regional	yes	1
1593	1593	3	3	B	E [trans-regional 1..e, Europe]. Cited by; 2. Provided multiple citations; 2	trans-regional	yes	1
1610	1610	3	3	B	E [trans-regional 1..e, Europe]. Cited by; 3. Provided multiple citations; 2	trans-regional	yes	1
1617	1617	3	3	B	E [trans-regional 1..e, South & North America, Caribbean]. Cited by; 3. Pro	trans-regional	yes	1
1626	1626	3	3	B	E [Italy only (2)]. Cited by; 2.		yes	1
1679	1679	3	3	B	E [trans-regional, Europe, moving westward. Massive waves of epidemics	trans-regional	yes	1
1708	1708-10	3	3	B	E [trans-regional; Western Europe (2,3,5), severe infections reported & s	trans-regional	yes	3
1712	1712	3	3	B	E [trans-regional; Europe (2), Europe N to S (1), locally severe infections (2)	trans-regional	yes	2
1718	1718-20	3	3	B	E [trans-regional; N & S America (1 in 1719-20)]. Cited by; 1, 2. Multiple cit	trans-regional	One continent cited	2
1793	1793	3	3	B	E [classified by author (2)]. Cited by; 2. Multiple citations provided; 2.	NS	yes	1
1824	1824-27	3	3	B	E [trans-regional; western Hemisphere (2)]. Cited by; 1, 2. Multiple citation	trans-regional	yes	2
1647	1647-48	1(zoo)(Equine)	1	A	P [≥2 continents, trans-regional; N & S America, Europe, associated with ex	≥2 continents	≥2 continents (CB: 3	3
1729	1729-33	1(zoo)(Equine)	1	A	P [≥2 continents; spread Russia to Europe, then south, Eurasia, then Ame	≥2 continents	≥2 continents plus	6
1761	1761-62	1(zoo)(Equine)	1	A	P [≥2 continents; Americas (1), Europe (1,2), then worldwide (3). within 1 y	≥2 continents	yes	4
1889	1889-93	1(zoo)(Equine)	1	A	P [≥2 continents; spread from Asia (3,7) or uzbekistan (2), to Russia (3,5,7),	≥2 continents	yes	6
1957	1957-58	1(zoo)(avian)	1	A	P [≥2 continents; China and Asia (2,3,5,6,7), Europe (3,6) Globally (1,3,5,6).	≥2 continents	yes	7
2009	2009	1(zoo)(porcine)	1	A	P [≥2 continents; spread quickly and globally (1) by Airlines (1). Zoonosis	≥2 continents	yes	3
1655	'55-1658	2(zoo)(Equine)	2	A	P? [≥2 continents; trans-regional; Europe (1,3), but by including the 1655	≥2 continents	≥2 continents (CB: 2	4
1899	'99-1900	2(zoo)(Equine)	2	A	P [possible pandemic (2). a mild pandemic (5). Serological data link to H3N	NS	yes (CB: 2/3 classify	3
1675	1675-76	3(zoo)(Equine)	3	A	E [trans-regional; Europe, non-directional spread, associated with equine	trans-regional	yes	4
1688	1688	3(zoo)(Equine)	3	A	E [trans-regional; Britain (2), pan-Europe (4), starting with equine epizootic	trans-regional	yes	2
1693	1693	3(zoo)(Equine)	3	A	E [trans-regional; Europe (2,4), British Isles (2), associated with equine epiz	trans-regional	yes	3
1697	1697-98	3(zoo)(Equine)	3	A	E [trans-regional; N & S America, starting with equine epizootics and ending	trans-regional	One continent cited	3
1727	1727	3(zoo)(Equine)	3	A	E [trans-regional; Europe (4). Associated with a severe equine epizootic fa	trans-regional	yes	2
1872	1872-75	3(zoo)(Equine)	3	A	P [trans-regional; Western Hemisphere (1), USA (4). Possible pandemic (2; t	trans-regional	CB: (2/4 classifed a	4
1915	1915-16	3(zoo)(Equine)	3	A	E [trans-regional; USA (1,4). Associated with widespread equine epizootic	trans-regional	yes	2
1976	1976	3(zoo)(porcine)	3	A	E [USA. Zoonosis porcine origin (1,4,5,7), human-to-human transmission	USA	yes	4

292 **Total solar irradiance (Associated with influenza pandemics)**. Reconstruction was based on NRLTSI2 (Coddington et al., BAMS, 2015 doi: 10.1175/BAMS-D-14-00265.1). http://spot.colorado.edu/~koppg/TSI/TIM_TSI_Reconstruction.txt.



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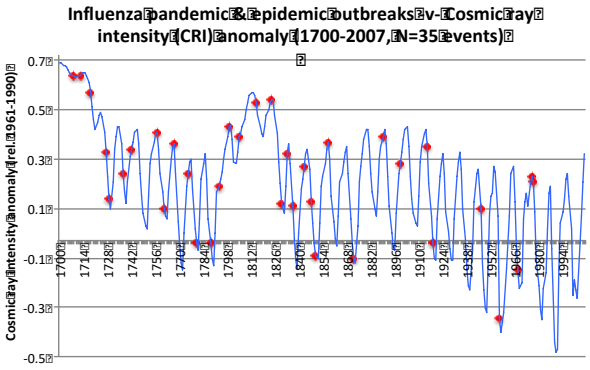
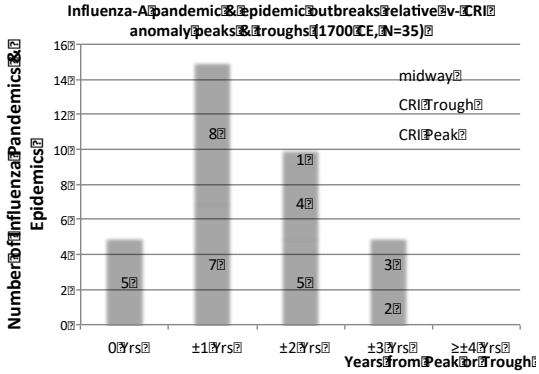
Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs)(2)	Ave. TSI (for century period)(3)	Ave. TSI (of events in period)(4)			
1610-1699	10	9.0	-0.812	-0.870	Percent +ve TSI Anomaly	41	89.1%
1700-1799	15	6.7	-0.588	-0.572	Percent -ve TSI Anomaly	5	10.9%
1800-1899	13	7.7	-0.527	-0.510			
1900-1999	7	14.3	-0.145	0.035	Average peak-trough or trough to peak interval (yrs)		5.1
Variables (Pearson)	**1 v-3**	**1 v-4**	**2 v-3**	**2 v-4**	(in the solar cycle associated with the the event)		
Pearson (1610-1999)	-0.51	-0.53	0.76	0.78	STDEV		1.7
P-value			0.24	0.22			
Pearson (1700-1999)	-0.993	-0.989	1.0000	0.9995	Average P:T or T:P for solar cycles in the series (Yrs)		5.1
P-value	0.08		<0.00001	<0.00001	STDEV		1.6

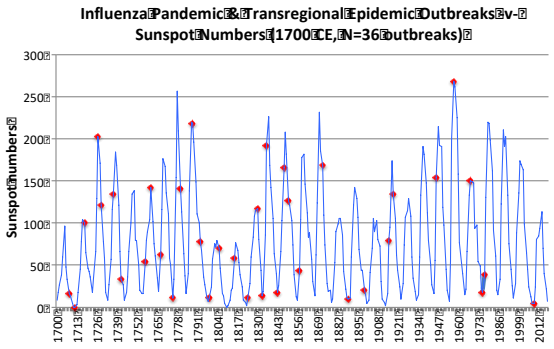
293 **Cosmic ray intensity (Associated with influenza pandemics)**. Usoskin, I.G., et al. 2008. Cosmic Ray Intensity Reconstruction. IGBP PAGES/World Data Center for Paleoclimatology. Data Contribution Series # 2008-013. NOAA/NCDC Paleoclimatology Program, Boulder CO, USA. Original References: 1) I.G. Usoskin et al., 2002, A physical reconstruction of cosmic ray intensity since 1610. Journal of Geophysical Research, 107(A11), 1374. Downloaded May 2018. ftp://ftp.ncdc.noaa.gov/pub/data/paleo/climate_forcing/solar_variability/usoskin-cosmic-ray.txt.

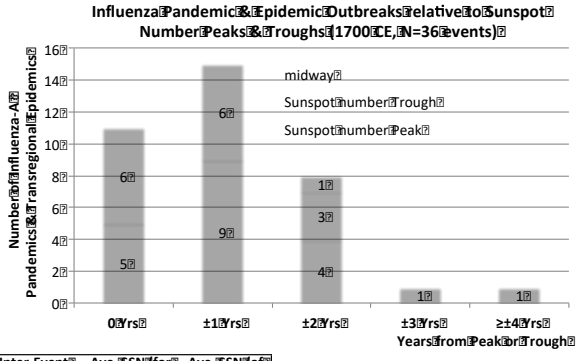

Influenza pandemic & Epidemic outbreaks v- Cosmic ray intensity (CRI) anomaly (1700-2007, N=35 events)
Cosmic ray intensity anomaly (rel. 1961-1990)


Influenza-A pandemic & Epidemic outbreaks relative v- CRI anomaly peaks & troughs (1700 CE, N=35)
midway
CRI Trough
CRI Peak
Number of Influenza Pandemics & Epidemics
Years from Peak or Trough

Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs)(2)	Ave. CRI (for century period)(3)	Ave. CRI (of events in period)(4)			
1700-1799	15	6.7	0.337	0.332	No. & Percent +ve CRI Anomaly	7	20.0% high solar activity
1800-1899	13	7.7	0.281	0.280	No. & Percent -ve CRI Anomaly	28	80.0% low solar activity
1900-1999	7	14.3	0.078	0.080	Average peak-trough or trough to peak interval (yrs)		5.8
Variables (Pearson)	**1 v-3**	**1 v-4**	**2 v-3**	**2 v-4**	(in the solar cycle associated with the the event)		
Pearson (1700-1999)	0.999	0.999	-0.997	-0.997	STDEV		1.7
P-value	0.028	0.028	0.049	0.049	Average P:T or T:P for solar cycles in the series (Yrs)		5.2
					STDEV		1.4

294 **Sunspot numbers (Associated with influenza pandemics)**. Sunspot data from the World Data Center SILSO, Royal Observatory of Belgium, Brussels. http://sidc.be/silso/datafiles#total.




Influenza Pandemic & Epidemic Outbreaks relative to Sunspot Number Peaks & Troughs (1700 CE, N=36 events)
midway
Sunspot Number Trough
Sunspot Number Peak
Number of Influenza-A Pandemics & Transregional Epidemics
Years from Peak or Trough

Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs)(2)	Ave. SSN (for century period)(3)	Ave. SSN (of events in period)(4)
1700-1799	15	6.7	76.2	88.7
1800-1899	13	7.7	72.7	78.3
1900-1999	7	14.3	90.0	120.7
Variables (Pearson)	**1 v-3**	**1 v-4**	**2 v-3**	**2 v-4**
Pearson (1700-1999)	-0.909	-0.887	0.951	0.935
P-value			0.20	

295 Jiangwen Qu, "Is sunspot activity a factor in influenza pandemics?" Reviews in Medical Virology 2016 Sep;26(5):309-13. doi: 10.1002/rmv.1887. Epub 2016 May 2. [**Statistical significance was confirmed.** "*Methods: Descriptive epidemiology was used to analyse the association between influenza pandemics and possible pandemics and relative number of sunspots. Non-conventional*

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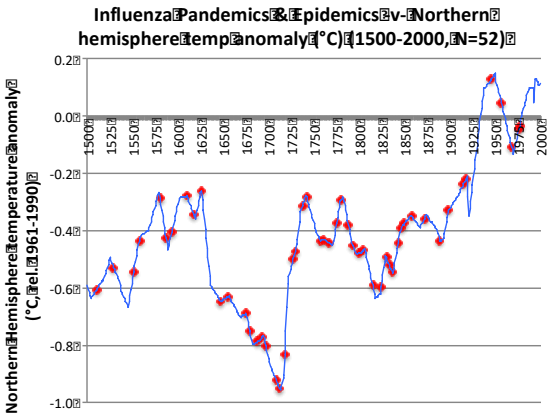
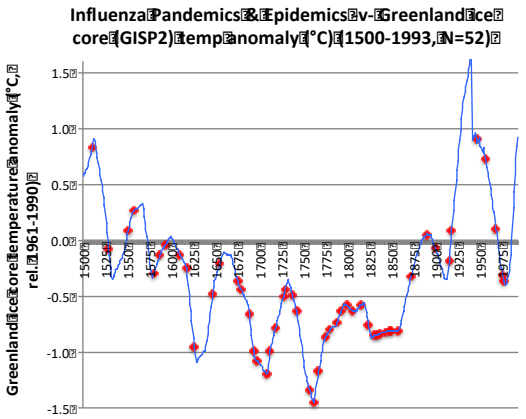
logistic regression was performed to analyse the statistical association between sunspot extremes and influenza pandemics to within plus or minus 1 year. Results: ***Almost all recorded influenza/possible pandemics*** *have occurred in time frames* ***corresponding to sunspot extremes, or +/– 1 year within such extremes.*** *These periods were identified as* ***important risk factors*** *in both possible and confirmed influenza pandemics (odds ratio: 3.87; 95% confidence interval: 1.08 to 13.85).*"]

296 **Northern Hemisphere temperature anomaly (Associated with influenza pandemics)**. T. Kobashi et al., 2013. Causes of Greenland temperature variability over the past 4000 year: implications for northern hemispheric temperature changes. Climate of the Past, 9(5), 2299-2317. doi: 10.5194/cp-9-2299-2013. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Northern Hemisphere 4000 Year Temperature Reconstructions. https://www.ncdc.noaa.gov/paleo/study/15535.



Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs)(2)	Ave. NHTemp anom.°C (for century period)(3)	Ave. NHTemp anom.°C (of events in period)(4)
1500-1599	7	14.3	-0.490	-0.463
1600-1699	10	10.0	-0.567	-0.597
1700-1799	15	6.7	-0.505	-0.505
1800-1899	13	7.7	-0.447	-0.454
1900-1999	7	14.3	-0.054	-0.068
Variables (Pearson)	**1 v- 3**	**1 v- 4**	**2 v- 3**	**2 v- 4**
Pearson (1500-1999)	-0.479	-0.501	0.541	0.575
P-Value				0.310
Pearson (1600-1999)	-0.715	-0.676	0.830	0.799
P-Value			0.170	
Pearson (1700-1999)	-0.992	-0.991	1.000	1.000
P-Value	0.081		<.00001	<.00001
No#, & Percent -ve NH Temp Anomaly			50	96.2%
No#, & Percent +ve NH Temp Anomaly			2	3.8%

297 **Greenland temperature anomaly (Associated with influenza pandemics).** T. Kobashi et al., 2017. Volcanic influence on centennial to millennial Holocene Greenland temperature change. Scientific Reports, 7, 1441. doi: 10.1038/s41598-017-01451-7. https://www.ncdc.noaa.gov/paleo-search/study/22057.



Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs)(2)	Ave. Greenland Temp anom.°C (for century period)(3)	Ave. Greenland Temp anom.°C (of events in period)(4)
1500-1599	7	14.3	0.144	0.09
1600-1699	10	10.0	-0.499	-0.56
1700-1799	15	6.7	-0.868	-0.84
1800-1899	13	7.7	-0.527	-0.63
1900-1993	7	13.4	0.400	0.14
Variables (Pearson)	**1 v- 3**	**1 v- 4**	**2 v- 3**	**2 v- 4**
Pearson (1500-1999)	-0.936	-0.951	0.941	0.973
P-Value	0.019	0.013	0.017	0.005
Pearson (1500-1899)	-0.939	-0.935	0.964	0.977
P-Value	0.061		0.036	0.023
Pearson (1600-1999)	-0.923	-0.931	0.954	0.965
P-Value	0.077	0.069	0.046	0.035
Pearson (1700-1999)	-1.000	-1.000	0.993	0.997
P-Value	<.00001	<.00001	0.075	0.049
No.# & Percent -ve Greenland Temp Anomaly			44	84.6%
No.# & Percent +ve Greenland Temp Anomaly			8	15.4%

298 **Arctic Sea-ice Cover proxy (Associated with influenza pandemics)**. Jochen Halfar et al., 2013, Arctic sea-ice decline archived by multicentury annual-resolution record from crustose coralline algal proxy. Proceedings of the National Academy of Sciences. doi: 10.1073/pnas.1313775110. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. Arctic Northwest Atlantic 646 Year Coralline Algae Sea Ice Record. https://www.ncdc.noaa.gov/paleo/study/15454.

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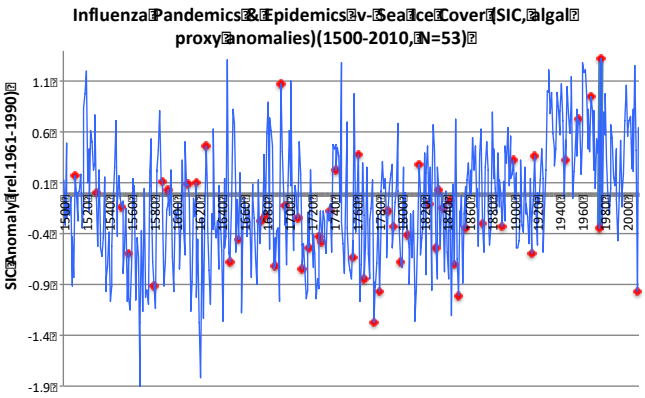
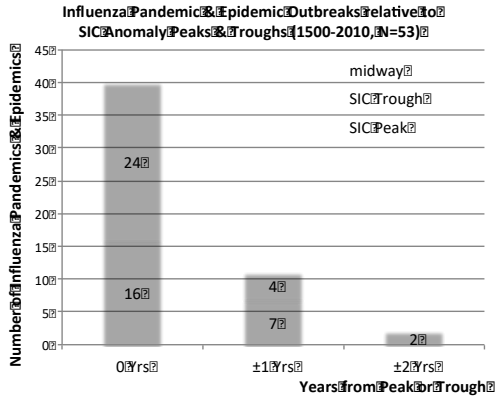
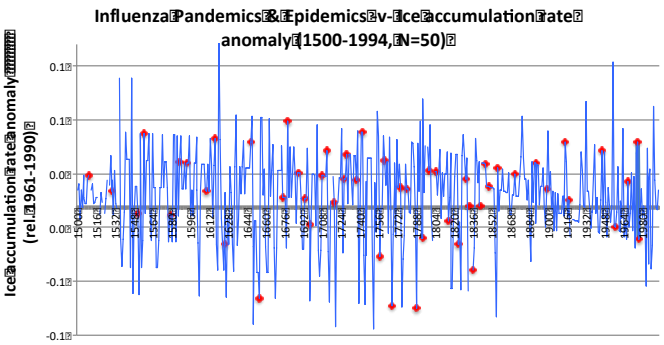
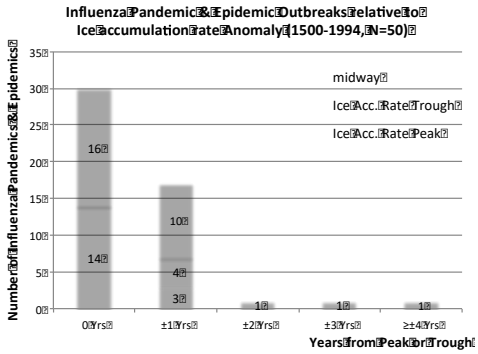




Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs) (2)	Ave. SIC anomaly (for century period) (3)	Ave. SIC anomaly (of events in period) (4)			
1500-1599	7	14.3	-0.258	-0.190			
1600-1699	10	10.0	-0.256	-0.073	No. # & Percent -ve SIC Anomaly	35	66.0%
1700-1799	15	6.7	-0.230	-0.460	No. # & Percent +ve SIC Anomaly	18	34.0%
1800-1899	13	7.7	-0.131	-0.258			
1900-1999	7	14.3	0.350	0.396	Average peak-trough or trough-to-peak interval (yrs)		3.2
Variables (Pearson)	**1 v- 3**	**1 v- 4**	**2 v- 3**	**2 v- 4**	(in the oscillation associated with the the event)		
Pearson (1500-1999)	-0.433	-0.757	0.476	0.732	STDEV		0.9
P-Value		0.138					
Pearson (1600-1999)	-0.761	-0.981	0.863	0.994			
P-Value		0.019		0.006			
Pearson (1700-1999)	-0.997	-1.000	0.999	0.995			
P-Value	0.049	<.00001	0.028	0.064			

299 **Ice accumulation rate (Associated with influenza pandemics)**. Beryllium-10 concentration anomaly data is based on; A.M. Berggren et al., 2009, A 600-year annual 10Be record from the NGRIP ice core, Greenland. Geophysical Research Letters, 36, L11801, doi:10.1029/2009GL038004. National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce. North GRIP - 600 Year Annual 10Be Data. https://www.ncdc.noaa.gov/paleo-search/study/8618.





Period (CE)	Number of Events per century (1)	Inter-Event Interval (Yrs) (2)	Ave. Ice Acc. Rate anomaly (for century	Ave. Ice Acc. Rate anomaly (of events in			
1500-1599	7	14.3	0.013	0.207	No. # & Percent -ve Ice Acc. Rate Anomaly	14	28.0%
1600-1699	10	10.0	0.008	0.194	No. # & Percent +ve Ice Acc. Rate Anomaly	36	72.0%
1700-1799	15	6.7	0.010	0.188			
1800-1899	11	9.1	0.013	0.193	Average peak-trough or trough-to-peak interval (yrs)		3.6
1900-1994	7	13.6	0.005	0.203	(in the oscillation associated with the the event)		
Variables (Pearson)	**1 v- 3**	**1 v- 4**	**2 v- 3**	**2 v- 4**	STDEV		3.0
Pearson (1500-1999)	0.240	-0.944	-0.214	0.991			
P-Value		0.016		0.001			
Pearson (1600-1999)	0.607	-0.962	-0.712	0.995			
P-Value		0.038		0.005			
Pearson (1700-1999)	0.594	-0.984	-0.722	1.000			
P-Value		0.114		<.00001			

300 **Warm Season Arctic Oscillation Reconstructions (AO-SAT and AO-SLP) (Associated with influenza pandemics)**. R.D. D'Arrigo et al., 2003, Warm Season Arctic Oscillation Reconstructions.

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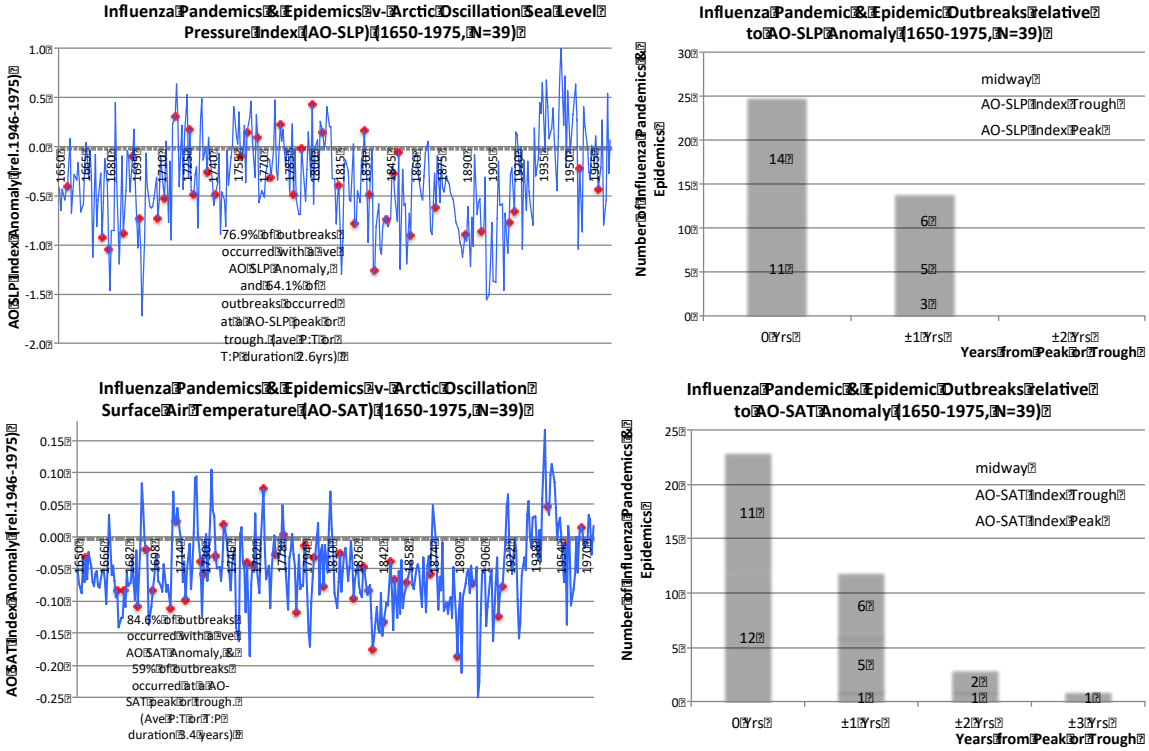
Contribution Series #2003-045. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA. https://www1.ncdc.noaa.gov/pub/data/paleo/treering/reconstructions/ao_darrigo2003.txt.


Influenza Pandemics & Epidemics v. Arctic Oscillation Sea Level Pressure Index (AO-SLP) (1650-1975, N=39)
AO SLP Index Anomaly (rel. 1946-1975)
76.9% of outbreaks occurred with a ±vel AO SLP Anomaly, and 64.1% of outbreaks occurred at an AO-SLP peak or trough. (Ave P:T or T:P duration 2.6yrs)
Influenza Pandemic & Epidemic Outbreaks relative to AO-SLP Anomaly (1650-1975, N=39)
midway
AO-SLP Index Trough
AO-SLP Index Peak
Number of Influenza Pandemics & Epidemics
14
11
6
5
3
0 Yrs
±1 Yrs
±2 Yrs
Years from Peak or Trough
Influenza Pandemics & Epidemics v. Arctic Oscillation Surface Air Temperature (AO-SAT) (1650-1975, N=39)
AO SAT Index Anomaly (rel. 1946-1975)
84.6% of outbreaks occurred with a ±vel AO SAT Anomaly, & 59% of outbreaks occurred at an AO-SAT peak or trough. (Ave P:T or T:P duration 3.4 years)
Influenza Pandemic & Epidemic Outbreaks relative to AO-SAT Anomaly (1650-1975, N=39)
midway
AO-SAT Index Trough
AO-SAT Index Peak
Number of Influenza Pandemics & Epidemics
11
12
6
5
2
1
1
0 Yrs
±1 Yrs
±2 Yrs
±3 Yrs
Years from Peak or Trough

301 **Note:** The above cited and tabulated screening correlations were used to prioritize a more detailed statistical analysis (i.e., regression, non-conditional logistic regression, time-series analysis etc.), which is currently a work in progress. An earlier version of this data and its analysis was provided to WHO, US CDC, and a number of national healthcare agencies by email in Q1-2018 (multiple times) with a request for collaborative assistance, which was ignored.

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308 Global influenza strategy 2019-2030. Geneva: World Health Organization; 2019. License: CC BY-NC-SA 3.0 IGO. Cataloguing-in-Publication (CIP) data. CIP data are available at https://apps.who.int/iris/bitstream/handle/10665/311184/9789241515320-eng.pdf.

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339 **WHO Website**: Recommended composition of influenza virus vaccines for use in the 2013 southern hemisphere influenza season. 20 September 2012. Questions and Answers. Recommended composition of influenza virus vaccines for use in the southern hemisphere 2013 influenza season, https://www.who.int/influenza/vaccines/virus/recommendations/2013_south/en/, https://www.who.int/influenza/vaccines/virus/recommendations/201209_qanda_recommendation.pdf.

340 Freely available at Amazon https://amzn.to/2PyQsxV, Google Play http://bit.ly/2JFHz08, Kobo http://bit.ly/2F3DdRQ, and a PDF at Researchgate http://bit.ly/2UnTBju.

341 **Energy Information Agency 2016 (EIA)**: Global primary energy production and electricity generation. EIA: (1) Primary energy production, http://bit.ly/2mrPuGO. (2) Electricity generation, http://bit.ly/2m6JVNy.

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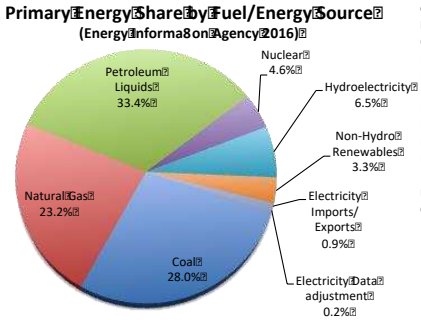

GLOBAL PRIMARY ENERGY PRODUCTION (Quadrillion BTU)	2006	2016	2016 % Share	10Yr CAGR
Coal	132.3	158.2	28.0%	1.8%
Natural Gas	106.0	130.9	23.2%	2.1%
Petroleum Liquids	169.5	188.5	33.4%	1.1%
Nuclear	27.7	25.7	4.6%	-0.7%
Hydroelectricity	29.9	36.9	6.5%	2.1%
Non-Hydro Renewables	4.8	18.4	3.3%	14.4%
Electricity Imports/Exports	4.2	4.9	0.9%	1.6%
Electricity Data adjustment	-1.1	1.1	0.2%	
	473.2	564.8	100.0%	1.8%

EIA: (1) Primary Energy Production, http://bit.ly/2mrPuGO. (2) Electricity Generation, http://bit.ly/2m6JVNy. Carlton Brown CC BY-SA. https://grandsolarminimum.com

342 **The IPCC disclosed our limited oil and gas reserves AR5 (without emphasis).** IPCC, Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. [See page 379. "*There is little controversy that oil and gas occurrences are abundant, whereas the reserves are more limited, with some 50 years of production for oil and about 70 years for natural gas at the current rates of extraction (Rogner et al., 2012). Reserve additions have shifted to inherently more challenging and potentially costlier locations, with technological progress outbalancing potentially diminishing returns (Nakicenovic et al., 1998; Rogner et al., 2012).*" Question: How will humans generate the carbon dioxide required to produce the global warming predicted by the IPCC for the 21st century with only 50 years of proven oil and gas left, while peak-discovery is history?].

343 **The IPCC disclosed our limited oil and gas reserves AR4 (without emphasis).** IPCC, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. [Exposé: See page 265, section 4.3.1. "*The proven and probable reserves of oil and gas are enough to last for decades and in the case of coal, centuries (Table. 4.2). Possible undiscovered resources extend these projections even further.*" Question: How will humans generate the carbon dioxide required to produce the global warming predicted by the IPCC for the 21st century with only decades of proven oil and gas left?].

344 **Energy Information Administration Data. 50 years of proven oil and gas reserves (see Revolution's Chapter 8):** Energy Information Administration data was obtained from: International Energy Statistics. These calculations utilized the following data files. Natural gas https://bit.ly/2LC6GBo, Crude Oil https://bit.ly/2IWeEaP, Coal data https://bit.ly/2L6pk3w. [Analysis: These reserve timeline estimates are calculated by dividing the 2013 Energy Information Agency's proven global oil, natural gas, and coal reserves by 2013 levels of production. This calculation tells us there are 50 years of proven oil and gas, and 130 years of coal reserves left. These reserve timeline estimates do not assume any population or economic growth, or a switch to a cold climate regime, which would accelerate energy demand and reduce the reserve timelines.].

345 Ian Chapman, 2014, "The end of Peak Oil? Why this topic is still relevant despite recent denials." Energy Policy, 64 . 93-101. http://insight.cumbria.ac.uk/id/eprint/1708/.

346 Declining Reserve Replacement Ratios Deceiving In Resource Play Environment. November. 28, 2017. View Issue. Maurice Smith. JWN Energy. Daily Oil Bulletin. https://www.sproule.com/application/files/2415/1188/2978/Sproule-Declining-Reserve-Replacement-Ratios-Nora-Stewart-Steve-Golko.pdf.

347 Tom Whipple, Online article. "Peak Oil Review." December 26, 2017. Originally published by ASPO-US. December 26, 2017. https://www.resilience.org/stories/2017-12-26/peak-oil-review-dec-26-2017/.

348 Kjell Aleklett and Colin J. Campbell, "The peak and decline of world oil and gas production." Minerals and Energy-Raw Materials Report 18.1 (2003): 5-20.

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349 All-time low for discovered resources in 2017: Around 7 billion barrels of oil equivalent was discovered. December 21, 2017. https://www.rystadenergy.com/newsevents/news/press-releases/all-time-low-discovered-resources-2017/.

350 **U.S. Energy Information Administration report guesses the unproven reserves.** Technically Recoverable Shale Oil and Shale Gas Resources. An Assessment of 137 Shale Formations in 41 Countries Outside the United States. June 2013. [Critique: See Table 2, page 3 for proven and unproven conventional and non-conventional energy reserves. The US Energy Information Agency reserve revisions mean that one-third of world gas and one-tenth of world oil resources are projections for shale resources. These revisions also mean that **50 percent and 70 percent of total conventional and unconventional oil and gas projections respectively are classified as unproven reserves (i.e., guesstimates)**. See pages 15-19, Methodology: These 2013 reserve revisions were based on predictions involving the application of historic US shale oil and gas recovery rates to foreign petroliferous basins with similar geophysical characteristics. These revisions assumed the same optimum operating context internationally as in the USA. See Chapter 8 of my book for a more detailed critique on this tenuous assumption.].

351 **U.S. Geological Survey guess unproven reserves**. T.R. Klett et al., 2015, U.S. Geological Survey assessment of reserve growth outside of the United States: U.S. Geological Survey Scientific Investigations Report 2015–5091. http://dx.doi.org/10.3133/sir20155091. [Critique: (1) See page 1; "*The U.S. Geological Survey estimated volumes of potential additions to oil and gas reserves for the United States by reserve growth in discovered accumulations. These volumes were **derived by using a new methodology** developed by the U.S. Geological Survey.*" **NB:** a new non-validated methodology. (2) See page 4; Assessment of Reserve Growth Outside of the United States "*Because recoverable volumes for individual reservoirs were not reported for many fields outside of the United States, the individual accumulation analysis was not used. Data acquired from individually analyzed U.S. accumulations were used as analogs in this study.*" Critique: Significant increases in US fossil fuel reserves resulted from the deployment of a new and non-validated forecasting methodology. Internationally, the reserve revisions were guesstimates, based on transferring historical precedents for the USA to overseas. None of these methods involved physically verifying the new reserves in the oil and gas wells or fields. That means these are unproven reserves].

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